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GUIDELINES FOR AIR QUALITY MAINTENANCE
PLANNING AND ANALYSIS. VOLUME I:
DESIGNATION OF AIR QUALITY MAINTENANCE
AREAS

Environmental Protection Agency
Research Triangle Park, North Carolina

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16. ABSTRACT These guidelines are to assist the states in identifying and proposing Air Quality Maintenance Areas (AQMAS). They contain criteria which the states may use in designating such areas. If the states fail to designate such areas within the timetable specified by EPA regulations, EPA shall use the criteria developed in the guidelines to establish AQMAS.			
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ERRATA
FOR
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VOLUME 1: DESIGNATION OF AIR
QUALITY MAINTENANCE AREAS

pg. 18, line 7 - change "fuel" to "full"

pg. 19, Table 2-1 Secondary Standard for Sulfur dioxide - change "24-hour" to
"3-hour"

pg. 26, line 4 - change "b." to "2."

pg. 34, 4.1.2.1 - after "Using emission summaries" add: "for each county in the
SMSA from state files, SIP emission summaries,"

pg. 35, 4.1.2.4 - after "obtain" add: "1975"

pg. 36, In Table 4-2 - under CO change 0.53 to 0.52

pg. 37, - after equation $Q_{1985} = \sum_{i=1}^I (Q \text{ base})_i G_i E_i$ add: "(4-1)"

pg. 38, - after equation $F_i = C_i (1 + D_i E_i)$ add: "(4-2)"

Under line 8, "F=1985 emissions . . .etc". add: "C = 1975 emissions
from source category i."

pg. 42, - at bottom of page, after "1. Baseline air quality . .", change "(b)"
to "(B)"

pg. 48, - line 17: after "In cities in which 1600 S/U" add: "<"

pg. 52, - in Table 5-2 - in (2) columns for 3 hr averaging times, underline 2.05
and 9.74

pg. 86, Table B-2 - in column G, "212,000" should be "213,200"

pg. 87, Item 11 - "212,000" should be "213,200"

pg. 93, - fourth line from bottom, change μ to u.

OAQPS GUIDELINE SERIES

The guideline series of reports is being issued by the Office of Air Quality Planning and Standards (OAQPS) to provide information to state and local air pollution control agencies; for example, to provide guidance on the acquisition and processing of air quality data and on the planning and analysis requisite for the maintenance of air quality. Reports published in this series will be available - as supplies permit - from the Air Pollution Technical Information Center, Research Triangle Park, North Carolina 27711; or, for a nominal fee, from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

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FOREWORD

This document is the first in a series comprising Guidelines for Air Quality Maintenance Planning and Analysis. The intent of the series is to provide State and local agencies with information and guidance for the preparation of Air Quality Maintenance Plans required under 40 CFR 51. The volumes in this series are:

- Volume 1: Designation of Air Quality Maintenance Areas
- Volume 2: Plan Preparation
- Volume 3: Control Strategies
- Volume 4: Land Use and Transportation Consideration
- Volume 5: Case Studies in Plan Development
- Volume 6: Overview of Air Quality Maintenance Area Analysis
- Volume 7: Projecting County Emissions
- Volume 8: Computer-Assisted Area Source Emissions Gridding Procedure
- Volume 9: Evaluating Indirect Sources
- Volume 10: Reviewing New Stationary Sources
- Volume 11: Air Quality Monitoring and Data Analysis
- Volume 12: Applying Atmospheric Simulation Models to Air Quality Maintenance Areas

Additional volumes may be issued.

All references to 40 CFR Part 51 in this document are to the regulations as amended through July 1974.

Preface

This document was originally published on January 11, 1974, by the Office of Air Quality Planning and Standards as OAQPS No. 1.2-016. Copies were distributed on January 15 to all Regional Offices and State Air Pollution Control Agencies. On January 23, 1974, errata were sent out for pages 5-8, B-10, B-11, C-5 and C-6. Copies of the guideline, including errata, were then distributed on February 8-15 to State A-95 Clearinghouses and those local air pollution control agencies and metropolitan and regional planning agencies which are located in SMSAs (Standard Metropolitan Statistical Areas) with population over 500,000.

Revisions to Sections 3 and 5 and Appendices A and B were distributed to all recipients of the guidelines on February 14, 1974.

All errata and revisions have been incorporated into this final edition of the guideline.

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DESIGNATION OF AIR QUALITY MAINTENANCE AREAS

1. INTRODUCTION

1.1 BACKGROUND

Pursuant to 40 CFR 51.12(e), published on June 18, 1973 in the Federal Register, Volume 38, p. 15834, all State Implementation Plans (SIPs) ". . . shall identify those areas (counties, urbanized areas, standard metropolitan statistical areas, etc.) which, due to current air quality and/or projected growth rate, may have the potential for exceeding any National Ambient Air Quality Standard (NAAQS) within the subsequent 10-year period." After areas are identified by the states, EPA will review these designations and will prepare an official list of areas by November 1974. The states must then perform a thorough air quality analysis of each of these areas; if this analysis shows that an area definitely will not maintain a NAAQS during the 10-year period, a plan must be developed for that area which demonstrates that the standard will be maintained.

As stated in the preamble to the above-cited laws, EPA intends to provide assistance to the states in (1) identifying the areas (i.e. Air Quality Maintenance Areas - AQMAs) that may exceed a national standard within the next 10 years, and (2) analyzing the impact of growth and development on air quality in such problem areas.

These present guidelines are to assist the states in identifying AQMA's and do not require as extensive an analysis as do the guidelines for analyzing the impact of growth, issued in the summer of 1974; guidelines for preparation of plans for maintenance of air quality will be issued in late summer of 1974. The overall timetable for plan development with regard to 40 CFR 51.12, paragraphs (e) through (h) is:

1. May 10, 1974 - State submission of identification of AQMA's.
2. November 1974 - EPA publication of list of AQMA's.
3. June 18, 1975 - State submission of:
 - a. Impact on air quality of projected growth in AQMA's.
 - b. Where needed, a plan to prevent any National Ambient Air Quality Standards from being exceeded over the 10-year period from the date of plan submittal.

A detailed timetable of state and EPA activity over the next 2 years for the maintenance of standards program is presented in Table 1-1.

EPA intends that the guidelines be easy to follow yet still be sufficiently responsive to ensure that as many appropriate AQMA's as possible are designated without over-designation. Because of the complex nature of the tasks involved and because of the many uncertainties inherent in the projection of emissions and air quality, the guidelines are written to obtain some degree of consistency in the information to be submitted by the states while still allowing for innovative approaches.

Prior to preparation of these guidelines, EPA consulted with several state and local air pollution control agencies and regional planning com-

missions. EPA has attempted to incorporate the advice thus obtained in these guidelines. Although every attempt has been made to anticipate and address questions that may arise, invariably unresolved issues will occur. When questions do arise, it is recommended that the appropriate EPA Regional Office be contacted for guidance.

The guidelines for AQMA designation are written for the state agency responsible for designation. In most cases this will be the state air pollution control agency. Because the impact of the provisions for maintenance of standards will affect areas that are of concern to other state agencies and local general purpose governments (such as those responsible for regional land use and transportation planning, water pollution control, etc.), it is advisable for the designating agency to solicit comments from these agencies and involve them in the designation process.

1.2 EPA DESIGNATION OF AQMAS

As indicated above, EPA will review the list of designated AQMAS submitted by the states and will publish, after allowing for public comment, an official list of AQMAS by November 1974. Because of time and manpower constraints, EPA will not be able to analyze in detail areas of those states which do not submit any material concerning AQMA designations. Consequently, EPA's designation for states that do not offer a submission will be on the basis of Standard Metropolitan Statistical Areas (SMSAs) whose growth rates for particular demographic-economic indicators, exceed a specified value. In addition, the

present value of the indicator, current air quality, and the meteorological conditions that present a pollution potential would be incorporated in EPA's criteria for AQMA designation. In most cases, actual emissions of air quality per se would not be projected by EPA. The critical growth rates would be determined as follows:

1. Percentage growth rates for population and earnings by industrial category have been obtained on an SMSA basis for the years 1975 to 1985.
2. SMSAs have been listed by regional priority classification for each pollutant and ranked by percentage growth rate for population and earnings by industrial category.
3. Using best judgment, demographic-economic indicators would be selected as representative of each pollutant-source category combination.
4. After scrutiny of the spread of growth rates, critical growth rates would be selected using best judgment for each demographic-economic indicator corresponding to a pollutant-source category combination.

The critical growth rates per demographic-economic indicator would vary depending on the pollutant priority classification of the AQCR in which the SMSA is located. Thus, a lower critical growth rate would be specified for those areas having a currently significant air quality problem (Priority I regions) than for those areas not having a currently significant air quality problem (Priority III regions).

1.3 FUTURE GUIDELINES

In addition to these guidelines on AQMA designation, EPA will publish other guidelines concerning the detailed analysis and projection of air quality for the AQMAs and the development of a plan for maintenance of NAAQS where needed. These future guidelines are briefly discussed below.

1.3.1 Guidelines for AQMA Analysis

The analysis step is intended to determine whether air quality limits are indeed threatened and, if so, when, where, and which are the principal sources involved. The results of this analysis will be useful in determining whether an SIP revision is necessary and in formulating alternative plans if they are needed.

Descriptive analysis would proceed along the general lines described below concerning analytical procedures for selecting AQMAs, although the analysis would be more thorough. In particular, the following steps would be followed.

1. The quantity of emissions of each pollutant for which the AQMA is designated would be projected to 1985. This projection would consider:
 - a. Present emissions by source category and, if possible, by location.
 - b. Expected growth of each source category based on past trends and highly probable future contingencies.
 - c. Present and highly probable future emission restrictions of new and existing sources.

2. The 1985 projected emission inventory would be allocated to the area in the least desirable* pattern that would be permitted under present land-use restrictions. This "scenario" is the one that would result in the most centralized locations of new sources of emissions. Present zoning patterns and land-use plans would be used in allocating new sources to the area.
3. Air quality for 1985 would be estimated from the emission-pattern scenario, preferably using a calibrated diffusion model. If this is impossible in the time available, a less sophisticated model must be used.

The models, emission factors, growth projection techniques, etc. suitable for performing the analysis will be forthcoming in the latter part of 1974.

1.3.2 Guidelines for Development of Air Quality Maintenance Plans

In late spring or summer of 1974, EPA will issue guidelines to the states on the preparation and submittal of 10-year air quality maintenance plans. These plans, which will be due on June 18, 1975, will pertain only to portions of states designated as AQMAs by the Administrator in November 1974. The guidelines will be organized around four subject areas. The first subject area relates to the mechanics of preparing and implementing the plans. Topics ranging from plan format to procedures for categorizing emission sources will be covered. The second subject area deals with the evaluation of the air quality

*Least desirable from an air quality maintenance standpoint.

implications of local land-use and transportation plans. It may be discovered in some AQMAs that growth plans are incompatible with air quality maintenance and will need to be revised. The third subject area will include a list of maintenance strategies. Emission allocations, transportation controls, fuel and energy conservation measures, and other strategies will be discussed, along with procedures to quantitatively estimate their impact on air quality. The final subject area will cover the coordination of air quality maintenance plans with other environmental planning activities such as water quality planning and the review of environmental impact statements.

Activity	Month	Year
EPA Drafts Guidelines for Analysis and Plan Development (9 months)	N	1973
	D	
	J	
	F	
	M	
	A	
	M	
	J	
	J	1974
	J	
	A	
	S	
	O	
	N	
	D	
	J	
	F	
	M	
	A	
	M	
	J	
	J	1975
	J	
	A	
	S	
	O	
	N	
	D	

Activity	Month	Year
EPA Issues AQMA Guidelines for Designating AQMAs	J	1973
States Submit Areas to be Designated as AQMAs	M	
EPA Begins Revisions of State Designations and Proposed Designations for States Failing to Submit AQMA Material	J	
EPA Announces Hearings on its Proposed Designation	J	1974
EPA Issues Analysis Guidelines to States	J	
EPA Holds Hearings on its Designations	J	
EPA Issues Plan Development Guidelines to States; Proposes Regs. on Same in Federal Register; Brief Regional Offices on Guidelines	S	
EPA Publishes Final Regulations on Plan Development in Federal Register	O	
EPA Publishes Final List of AQMAs	N	
Draft Plan Completed by States	F	
States Announce Hearings; Distribute Plans	A	
States Hold Hearings	M	
States Submit Plans to EPA	J	
EPA Starts Work on Plans for States that Fail to Submit Approvable Plans	J	1975
EPA Announces Approval/Disapproval of State Plans	A	
EPA Announces Hearings on Own Plans for States that did not Submit Approvable Plans	S	
EPA Holds Hearings on Own Plans	O	
EPA Promulgates Plans for States that have not Submitted Plans	N	

Table 1-1. MAINTENANCE OF AIR QUALITY STANDARDS
ACTIVITY SCHEDULE (Revised 4/15/74 and 8/1/74)

2. GENERAL INSTRUCTIONS AND DISCUSSION

The general approach that this guideline presents is depicted in Figure 2-1; the numbers in parentheses refer to the sections of the guideline in which that item is described:

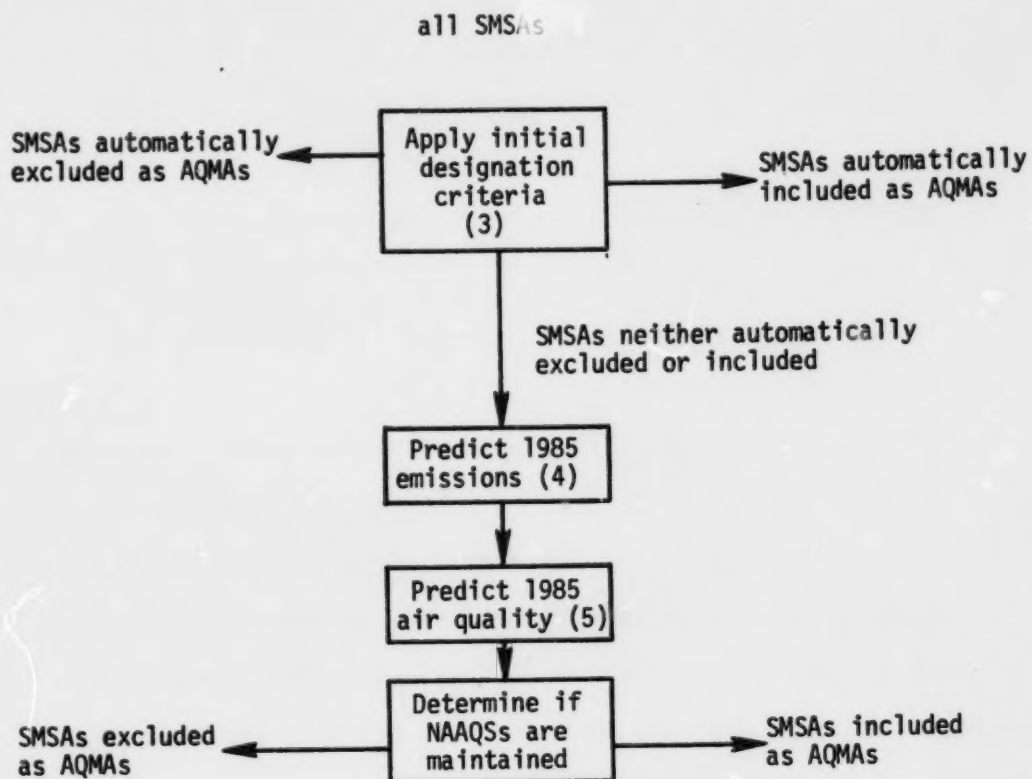


Figure 2-1. Flow Chart for AQMA designation

2.1 CONSIDERATION OF GEOGRAPHICAL AREAS

There appears to be a need to specify which areas, as a minimum, should be analyzed in determining which areas should be designated as AQMA's. The areas selected are the SMSAs as defined by the Office of Management and Budget (formerly the Bureau of the Budget). The reasons for choosing SMSAs are listed below:

1. SMSAs historically exhibit higher growth rates of population than non-MSA areas.
2. SMSAs exhibit the highest concentrations of population and industry.
3. Projections of population and economic indicators are available on an MSA basis.
4. Areas of SMSAs change with time as population density increases, facilitating future changes in the designation of AQMA's.
5. SMSAs account for roughly 70 percent of the nation's population, but only about 10 percent of the total land areas.

The MSA, alone or in its entirety, however, may not always be a desirable geographic area for designation as an AQMA. For instance, projections of emissions for cities, counties, or townships within the MSA may be possible to calculate, in which case it would be desirable to designate these as sub-MSA areas. In other cases, the projected growth in emissions may be expected to occur around the fringe of the MSA, in which case the designation may be more desirable if it includes that fringe area in addition to the MSA, in whole or in part.

Some consideration should be given to the difficulty of the actual designation and management of control programs within an AQMA. It is easier to designate by the names of the existing areas (political or non-political) than to delineate an area by listing roads, rivers, other topographical features, or latitude-longitude coordinates that constitute the boundaries of the area. Designation by currently defined areas, however, does not mean that the subsequent detailed analysis of the AQMA and possible control strategy must apply to the entire AQMA as originally designated--the analysis and plan can be restricted to selected problem areas within the AQMA. On the other hand, one should be aware that designated areas have been referenced in the proposed regulations for review of indirect sources in all but three states (38 F.R. 29893, Federal Register of October 30, 1973). If the regulation is promulgated as proposed, the size of facilities that would be exempt from review will be smaller in the designated areas (AQMA's) than in the non-designated areas. Until EPA publishes the list of AQMA's in November 1974, all SMSAs would, for purposes of the proposed indirect source review regulation, be considered designated areas.

In addition, one should be aware of possible relationships between the designated AQMA's and the areas to be chosen under the forthcoming regulations concerning significant deterioration. For instance, if the significant deterioration regulations provide that some (probably urban) areas are permitted to deteriorate up to the secondary national

ambient air quality standard, these areas will probably be the same areas as the AQMAs. Therefore, it might be appropriate to designate an area large enough to allow for the proper amount of desired growth.

A non-exhaustive list of types of areas that might be used for designation include:

1. AQCRs
2. SMSAs
3. Urbanized Areas
4. Counties
5. Groupings of: Cities, Townships, Boroughs
6. Planning regions used for transportation, land use or other planning
7. Sub-state planning districts

Designations should be pollutant-specific and should indicate the pollutants for which the area is designated. The detailed analysis required for each of the finally designated AQMAs would then be done only on the basis of those pollutants that are identified as problems in exceeding air quality standards in the future.

For uniformity and to avoid proliferation of designated AQMAs, a single boundary for each AQMA should be chosen regardless of the number of pollutants for which a potential problem exists. Actual pollutant problems within the area may overlap or be mutually exclusive (e.g., one part of an AQMA may experience growth in mobile source pollutants, whereas another part may suffer an increase in SO_2 emission from fuel combustion), but all the problem areas of a particular geographic

location should be enclosed in only one AQMA.

In the case of SMSAs that cross state boundaries, the respective states should coordinate their designations. An SMSA constitutes, by definition, "...for general economic and social purposes, a single community...". Therefore, it is recommended that, for an interstate SMSA, one AQMA be designated jointly by the respective states. It is highly desirable that one single integrated plan be adopted by all states involved. If this is not practical, however, then all state plans in interstate AQMA's should be at least compatible with one another.

It may be, however, that one state's portion of an SMSA will experience growth in emissions, while the adjacent state's portion will not; in this case, it may be desirable for the growth state to designate an AQMA in (and/or around) its portion of the SMSA, but for the non-growth state not to designate in its portion. Obviously, one state cannot designate a part of an AQMA, which is located in another state. Interstate cooperation will be necessary to resolve any conflicts.

The U.S. Department of Commerce, Bureau of Economic Activities (BEA) has developed projections of demographic and economic activity for SMSAs. BEA projections were made on the basis of SMSAs as they existed as of January 7, 1972. Chapter 6 includes the county composition of the SMSAs as they existed at that time. Since January 7, 1972, several revisions to the composition of SMSAs have been made, the latest in August 1972. Therefore, the January 7, 1972 SMSAs may have slightly different

boundaries than the currently defined SMSAs. The question arises as to which boundary should be used for AQMA designation. EPA recommends that the January 7, 1972 SMSAs be analyzed. Those SMSAs which are determined to be problem areas should then be designated as AQMAs on the basis of the current (1973) SMSA composition. For those SMSAs newly designated since 1972 and SMSAs in Puerto Rico for which no BEA projections exist, the states should develop their own basis for projection based on data from various planning agencies.

2.2 CONSIDERATION OF OTHER FACTORS

In deciding upon the particular boundaries of an AQMA, the following factors should be considered.

1. The AQMA should include all of the territory that shares common air envelope and a common aggregation of sources. This will usually be an urbanized area plus some adjoining areas that are now undeveloped but that are expected to develop in the next 10 years or so. It may include satellite communities that are now separated from the central urbanized area but will in 10 to 20 years, become part of the central urbanized area and thus share the air resource.
2. Use of areas previously designated by agencies of various kinds may have merit in that a data base may be available and a

proliferation of "regions" can be avoided. Examples are regional planning areas, state-designated planning areas, transportation planning areas, etc.

3. Emission control and other air conservation measures necessary to maintain air quality standards in the urbanized and developing parts of major urban centers may be quite stringent. Application of such stringent measures in isolated or undeveloped areas may not be advantageous. Thus, inclusion of large rural areas in an AQMA may not be desirable.
4. Design and implementation of air conservation measures will involve certain governmental agencies. Common boundary lines for AQMA's and one or some combination of jurisdictional areas of implementing agencies may have merit from an operational point of view.
5. Long-range transport of pollutants is another matter of concern. It is true that if ambient air standards are maintained near an aggregation of sources, such standards will also usually be maintained at more distant locations. Therefore, it may not be necessary to include those areas on the periphery of an aggregation of sources in order to assure maintenance of standards at locations distant from the aggregation of sources.
6. The influence of topography and geography on dispersion of pollutants and on overall community growth patterns should be considered.

7. When designating AQMA's, preparation of detailed air quality projections and development of any needed abatement strategies will need to be based on presently available land-use, transportation, and other plans because of time constraints. It may be, however, that new general regional development plans will be prepared in the future because of air quality considerations or other reasons. The AQMA designation would desirably be compatible with any such future community planning activity.

2.3 AQMA BOUNDARY CHANGES

The designation of the boundaries of an AQMA in May of 1974 does not preclude changes in such boundaries at the time that more detailed air quality analyses and abatement/maintenance plans are submitted in 1975, or at some other time.

2.4 WITHDRAWAL OF AQMA DESIGNATION

Areas designated in May or November 1974 may be "de-designated" if subsequent, more detailed analysis indicate that, in fact, the ambient air quality standards will not be jeopardized, in the coming 10 years. Therefore, in borderline cases arising in initial abbreviated analyses, it is appropriate to designate the area and proceed with more detailed analyses.

2.5 METROPOLITAN AREAS AND SPARSELY URBANIZED AREAS

The principal objective of designation of AQMA's and subsequent development of plans to maintain ambient air quality standards is to provide a mechanism for management of general overall urban growth as related to air quality, with due consideration of other aspects of community growth. New source review procedures, which involve determination that the new source will meet emission regulations and not cause or contribute to contravention

of ambient air quality standards, will be a part of the overall maintenance plan in urban areas. In lightly urbanized areas and in rural areas, it is considered that properly administered new source review procedures will be adequate to assure maintenance of air quality standards and, therefore, more complex and burdensome maintenance programs will not ordinarily be needed.

2.6 ASSUMPTIONS CONCERNING FUEL AVAILABILITY

In projecting emissions from fuel-burning sources, certain assumptions must be made concerning the future availability and use of types of fuel. The assumptions used must be specified in the material submitted in support of the designation. These will be considered valid if based upon current trends and/or projected fuel-use requirements. New facilities that might change local fuel-use patterns, e.g., refineries, nuclear power plants, oil pipelines, coal gasification facilities, etc., but that have not already been committed for completion by 1985, cannot be assumed to have an impact on fuel availability in the designation process. In addition, the current fuel shortage cannot be assumed to continue ad infinitum, thus, resulting in zero growth in emissions from fuel combustion.

2.7 ASSUMPTIONS CONCERNING EMISSION AND AIR QUALITY BASELINES

Emission baseline--In order to estimate emissions between the time standards are attained and 1985, it is necessary to determine emissions at the time standards are attained. Some SIPs contain these projections of emissions, and these can be used when available. If not available, these attainment date emissions can be calculated by the method presented below, which is based on concepts developed in the Manual for Analysis of State Implementation Plan Progress, prepared for EPA by the Research Triangle

Institute¹. Regulations currently in existence should be used to project emissions. Regulations that are planned, but not yet promulgated, will not be accepted for such projections in the designation process.

Air quality baseline--Several of the models presented below for use in predicting air quality require the use of air quality data at the time of implementation of existing regulations. As with emissions, the SIPs may contain projections of air quality at the time of final SIP implementation, and these air quality values can be used. For cases where air quality projections are not contained in the SIP, it may be assumed that the NAAQS will be achieved, unless there is reason to believe otherwise. Alternatively, recent (1972 and 1973) air quality data may be projected to 1975 and hence to 1985, making proper adjustments for growth and scheduled abatement actions.

Because of the nature of photochemical oxidants, there may be rural areas that experience high oxidant concentrations caused by hydrocarbons emitted from either distant man-made sources or natural sources. It is recommended that these rural areas not be designated as AQMAs in that it would be meaningless to design a control strategy for them since they do not contain controllable sources of hydrocarbons. In addition, Federal programs are planned that will eventually reduce hydrocarbon emissions nationwide.

A similar problem exists for areas subject to high concentrations of total suspended particulate matter caused by uncontrollable fugitive dust from natural causes. It is recommended that particulate matter measurements resulting from such fugitive dust not be the basis for projecting air quality for the purpose of AQMA designation.

¹Manual for Analysis of State Implementation Plan Progress. Research Triangle Institute. Research Triangle Park, North Carolina 27709. Prepared for: Office of Air Quality Planning and Standards, Environmental Protection Agency. Contract No. 68-02-0294. March 1974.

2.8 CONSIDERATION OF AIR QUALITY STANDARDS

The following national ambient air quality standards shown in Table 2-1 should be considered in designating areas in which standards may be exceeded.

Table 2-1. NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary	Secondary
Particulate matter	(a) 75 $\mu\text{g}/\text{m}^3$, annual geometric mean (b) 260 $\mu\text{g}/\text{m}^3$, second highest 24-hr average per year	150 $\mu\text{g}/\text{m}^3$, second highest 24-hr average per year
Sulfur dioxide	(a) 80 $\mu\text{g}/\text{m}^3$, annual arithmetic mean (b) 365 $\mu\text{g}/\text{m}^3$, second highest 24-hr average per year	1300 $\mu\text{g}/\text{m}^3$, second highest 24-hr average per year
Carbon monoxide	10 $\mu\text{g}/\text{m}^3$, second highest 8-hour average per year	
Photochemical oxidants	160 $\mu\text{g}/\text{m}^3$, second highest 1-hour average per year	
Nitrogen dioxide	100 $\mu\text{g}/\text{m}^3$, annual arithmetic average	

For carbon monoxide, assume that the 1-hour standard will be maintained if the 8-hour standard is maintained. As in the original SIPs, a demonstration of achieving the oxidant standard will imply that the hydrocarbon standard also has been achieved.

Although states may designate on the basis of air quality standards more stringent than the national ambient air quality standards, EPA will, should the occasion ever arise, only act to the extent necessary to ensure attainment of the national ambient air quality standards.

2.9 PROJECTION REQUIREMENTS

Air quality standards must be maintained throughout the 10 years following submission of the detailed analysis of the AQMAs. Projections of air quality must, therefore, be made for the year 1985 and for any other

years within the 10-year period in which it is believed that concentrations may temporarily exceed a NAAQS.

2.10 SUPPORTING INFORMATION

For each SMSA within the state that is exempted from designation on the basis of the initial criteria (presented below), the submittal must include the reasons for the exemption.

For each SMSA within the state which is not exempted based on the initial criteria, a projection of air quality for each pollutant not exempted must accompany the submittal. Such projections must include all calculations, except where a computerized model is used. If a computerized model is employed, the submittal must describe the model used. If the projection method is not one of the methods recommended by EPA below, the submittal must describe the method.

A summary table of the designations and rationale similar to that presented in Table 2-2 should accompany the submittal.

Table 2-2.

Summary of AQMA Designations for State of _____							
Area ^a	Reason not designated ^b	Reason designated ^b	Designation for				
			TSP	SO ₂	CO	O _x	NO ₂

^aMust include at least all SMSAs within the state.

^bReasons would be either "Initial Criteria" or "Actual Projection."

2.11 PROCEDURAL REQUIREMENTS

The areas designated by the states and eventually by EPA will have the force of regulation by virtue of the requirement that (1) for these areas, a determination must be made of whether NAAQS will be maintained, and (2) a plan may have to be submitted for maintenance of the standards. Because of these reasons, designations must be subjected to public hearing prior to submission to EPA by May 10, 1974. The rationale behind the requirement of public hearing on AQMA designation is basically that the decision to designate or not designate areas as AQMA is of such importance, considering the economic and developmental implications of such decisions, that the widest public participation in such decisions should be allowed. In holding such hearings, the states should consider the rationale upon which decisions were made to include or exclude all SMSAs, or parts thereof, within their boundaries.

The regulations concerning public hearings and submission of plans (40 CFR 51, Sections 51.4 and 51.5) are applicable with regard to submission of the designated area.

3. INITIAL DESIGNATION CRITERIA

The criteria immediately below were developed to enable the states to eliminate obvious non-problem areas and include obvious problem areas without performing an analysis of projected air quality. Any SMSA that is not either eliminated or automatically included as an AQMA under these criteria is expected to undergo the analysis described in Section 4 of this document to determine the 1985 emissions. After application of these initial criteria, any SMSA that is not automatically excluded or included is expected to undergo a projection of 1985 emissions and air quality by techniques such as those presented in Sections 4 and 5 of these guidelines. Bear in mind that in case of a conflict between inclusion and exclusion criteria, inclusion criteria take precedence.

The technical derivation of these criteria is presented as Appendix A.

3.1 ELIMINATION OF OBVIOUS NON-PROBLEM AREAS

SMSAs that meet the following criteria may be automatically excluded from consideration as an AQMA for the particular pollutant; supporting information must substantiate this exclusion.

1. Particulate matter:

SMSAs that are located in AQCRs where data for the past 2 years indicates the AQCR is below all NAAQS.

2. Sulfur dioxide:

SMSAs that are located in AQCRs where data for the past 2 years indicated that the AQCR is below all NAAQS and, the product of (1) the air quality concentration in the past year and (2) the relative growth in SMSA total earnings between the base year and 1985 is less than the

national ambient air quality standards.

3. Carbon monoxide:

Use Figure 3-1 and the following procedures to determine those SMSAs that can be excluded from consideration as an AQMA.

a. Estimate the percent contribution of CO emissions from light-duty vehicles to total mobile source carbon monoxide emissions on heavily used, central city streets; choose the area where LDV contribution is representative of the local area in the vicinity of the air quality monitoring site.

b. Locate the point of Figure 3-1 corresponding to the highest measured 8-hour CO concentration in the central city in 1970 and the LDV contribution to local mobile source emissions estimated under (a) above.

c. If the intersection determined in (b) above lies on or below the curve, the area may be automatically eliminated from consideration as an AQMA; if the point lies above the curve, proceed with the analysis described in Section 5-2.

4. Photochemical oxidants:

SMSAs which have no transportation control strategy for photochemical oxidants and which are located in AQCRs with a maximum 1-hour oxidant concentration of less than 320 ug/m^3 during the past 2 years are excluded.

5. Nitrogen dioxide:

a. SMSAs not designated by the inclusion criteria in Section 3.2(e) are excluded.

3.2 INCLUSION OF OBVIOUS PROBLEM AREAS

Areas that meet any one of the following criteria should be designated, in whole or at least in part, as an AQMA for the particular pollutant.

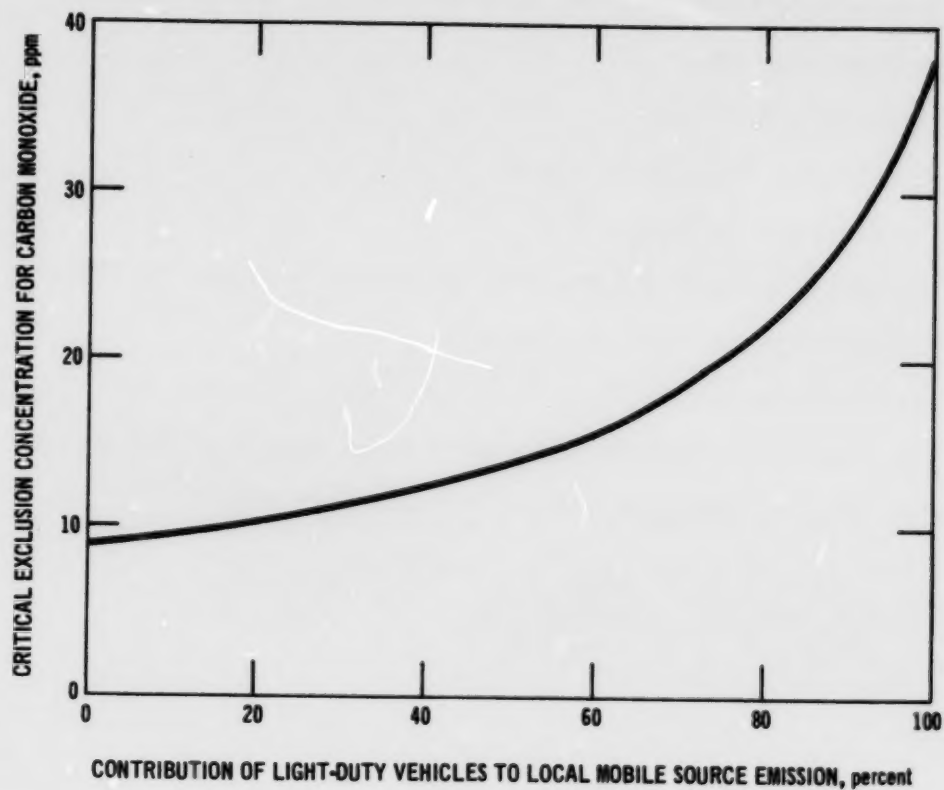


Figure 3-1. Exclusion criteria for carbon monoxide as a function of the distribution of emissions between light- and heavy-duty vehicles on local streets.

1. Particulate matter:

Areas within AQCRs that are not projected to attain the NAAQS for particulate matter by 1985.

b. Sulfur dioxide:

Areas within AQCRs that are not projected to attain the NAAQS for sulfur dioxide by 1985.

3. Carbon monoxide:

No automatic inclusion criteria.

4. Photochemical oxidants:

Any areas for which a transportation control strategy for photochemical oxidants is required (Table 3-1).

5. Nitrogen dioxide:

The appropriate parts of those SMSAs whose central cities are Los Angeles, Chicago, New York, Denver, and Salt Lake City.

Table 3-1. AQCRs IN WHICH TRANSPORTATION CONTROL STRATEGIES ARE REQUIRED

State	AQCR	Required for	
		CO	Ox
Alaska	Northern Alaska Intrastate	x	
Arizona	Phoenix-Tucson Intrastate	x	
California	San Francisco Bay Area Intrastate	x	x
	Sacramento Valley Intrastate	x	x
	Metropolitan Los Angeles Intrastate	x	x
	San Joaquin Valley Intrastate	x	x
	San Diego Intrastate	x	x
	Southeastern Desert	x	x
Colorado	Metropolitan Denver Intrastate	x	x
District of Columbia	National Capital Interstate	x	x
Illinois	Metropolitan Chicago Interstate	x	
Indiana	Metropolitan Indianapolis Interstate	x	x
Maryland	National Capital Interstate	x	x
	Metropolitan Baltimore Intrastate	x	x
	Metropolitan Boston Intrastate	x	x
Massachusetts	Hartford-New Haven-Springfield Interstate	x	x
Minnesota	Minneapolis-St. Paul Interstate	x	x
Missouri	Metropolitan St. Louis Interstate	x	
New Jersey	New Jersey-New York-Connecticut Interstate	x	x
	Metropolitan Philadelphia Interstate	x	x
New York	New Jersey-New York-Connecticut Interstate	x	x
	Genesee-Finger Lakes Intrastate		x
Ohio	Metropolitan Cincinnati Interstate		x
Oregon	Portland Interstate	x	x
Pennsylvania	Metropolitan Philadelphia Interstate	x	x
	Southwest Pennsylvania Intrastate	x	x
Rhode Island	Metropolitan Providence Interstate	x	x
Texas	Metropolitan San Antonio Intrastate		x
	Metropolitan Dallas-Ft. Worth Intrastate		x
	Austin-Waco Intrastate		x

Table 3-1 (continued). AQCRs IN WHICH TRANSPORTATION CONTROL STRATEGIES ARE REQUIRED

State	AQCR	Required for	
		CO	Ox
Texas (cont.)	El Paso-Las Cruces-Alamagordo Interstate		x
	Corpus Christi-Victoria Intrastate		x
	Metropolitan Houston-Galveston Intrastate		x
	Southern Louisiana-Southeast Texas Interstate ^a		x
Utah	Wasatch Front Intrastate	x	
Virginia	National Capitol Interstate	x	x
Washington	Puget Sound Intrastate	x	
	Eastern Washington-Northern Idaho Interstate	x	

a. Currently under study; may require only stationary source control.

4. METHODS FOR PROJECTING EMISSIONS

In order to identify those SMSAs that could become AQMA's during the period of 1975 to 1985, it will be necessary to first determine 1970 emissions, project these emissions to 1975 (or 1977 for areas granted extensions) to account for current SIP control strategy reductions, and then further project emissions to 1985 using Bureau of Economic Analysis indicators of growth in population and earnings for SMSAs. From the 1985 emissions, air quality can then be estimated by techniques presented in Section 5 and compared with the applicable standards to determine if the area being considered should, in fact, be designated as an AQMA. In many cases, 1975 emissions will already have been estimated for the purpose of developing SIP control strategies. In the event that 1975 emissions are given in the state's implementation plan by county and they are still valid, they may be used directly, and no projection to 1975 would, of course, be necessary. For ease in both computation and review, emissions can be recorded by county within each SMSA as shown in Table 4-1. A suggested process for projecting emissions is presented in the flow diagram of Figure 4-1.

Table 4-1. EMISSION PROJECTION CALCULATIONS^a

A Source class	B 1970 emissions	C Reduction factors	C-1 Growth factor (1975/1970)	D 1975 emissions	E Growth rate [(1985/1975)-1]	F Emission factor adjustment	G 1985 emissions $G = D(1 + EF)$
Fuel combustion							
Power plants							
Point sources ^b							
Area sources							
Subtotal							
Industrial process							
Point sources (Subtotal)							
Solid waste disposal							
Point sources							
Area sources							
Subtotal							
Transportation							
AV							
DV							
Subtotal							
Miscellaneous							
Point sources							
Area sources							
Subtotal							
TOTAL							

^aA table such as this should be prepared for each pollutant.

^bPower plants excluded.

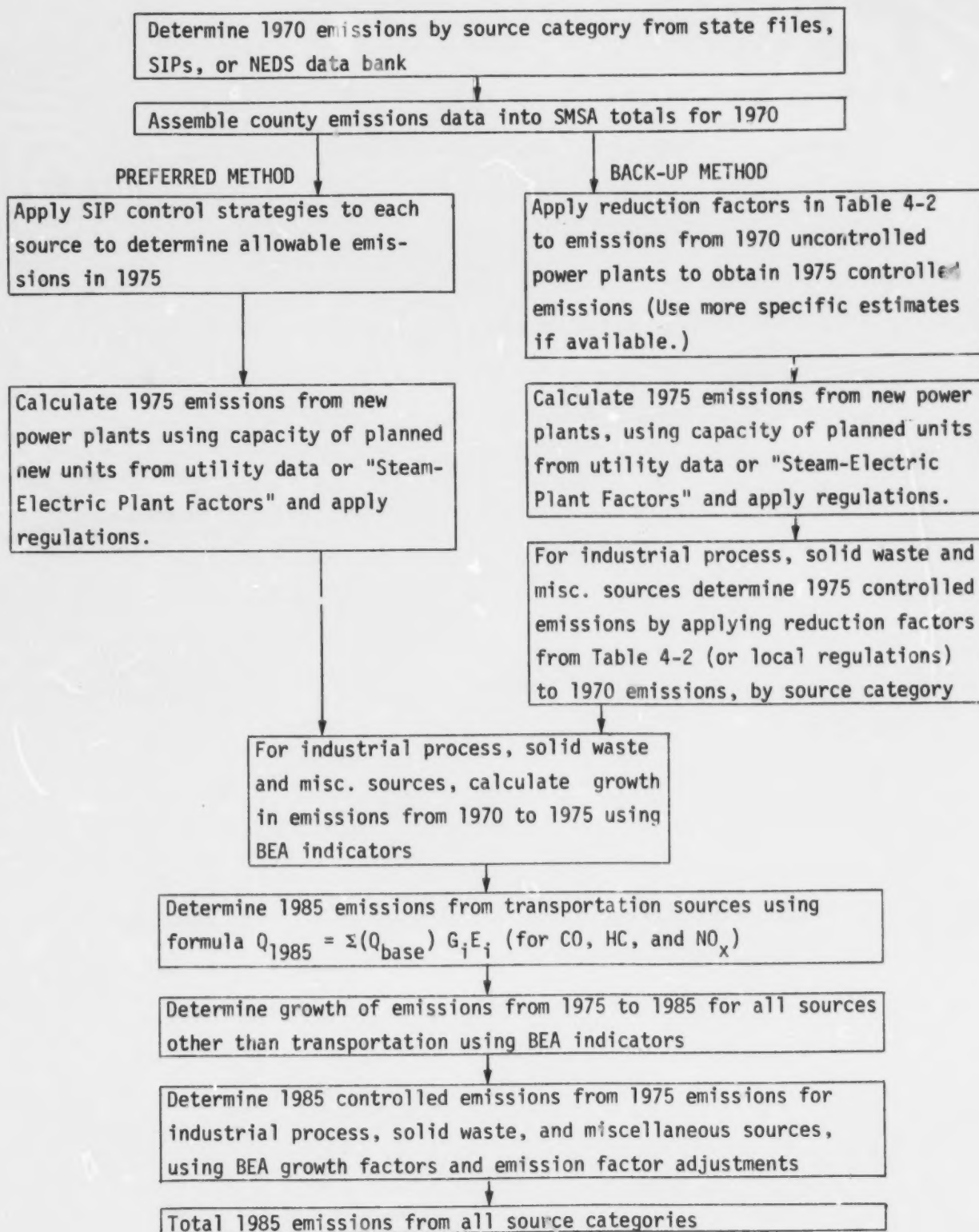


Figure 4-1. Calculation of 1975 and 1985 emissions.

4.1 PROJECTING 1975 EMISSIONS

Two methods for projecting 1975 emissions are presented below, a "preferred" method and a "back-up" method. By implication, EPA expects the "preferred" method to be used for the most part in each state. Only where time does not permit or where the workload will be great (such as for those states that have a large number of SMSAs to be analyzed), should the "back-up" method be used. Before deciding to use the "back-up" method, states should discuss the problems of using the "preferred" method with the representative responsible for maintenance of standards in the appropriate EPA Regional Office. CO, HC, and NO_x emissions from transportation sources can be calculated to 1985 directly by the method presented below in Section 4.2.

4.1.1 Preferred Method

This method is the same as that used in the development of the original implementation plans, i.e., a source-by-source tabulation of emissions allowed under the applicable control strategies contained in the state's implementation plan. Data should be presented and submitted in a form similar to that presented in Appendix D of 40 CFR, Part 51.

For projections of new steam-generating power plants, it is recommended that states contact electric utility companies directly. If time does not permit this, use 1975 projections of new capacity in the latest edition of "Steam-Electric Plant Factors" published by the National Coal Association.

After the source-by-source tabulation of allowable emission has been computed, tabulate the allowable emissions into the following categories, and use the recommended projection parameter to account for growth to 1975.

<u>Category</u>	<u>Recommended BEA Projection Parameter*</u>
Fuel combustion (excluding power plants)	Total earnings
Industrial processes	Manufacturing earnings
Solid waste	Population
Miscellaneous	Total earnings

Emissions from these four categories and power plants can be recorded in Table 4-1.

4.1.2 Back-up Method

The following technique is based on 1970 summary NEDS data, and uses average emission reduction factors derived from analysis of point source

*EPA's recommendation that these parameters be used was based upon available information and was not the result of a statistical analysis to determine an accurate correlation between emissions from a particular category and an economic or demographic parameter. Furthermore, the user of these projections should be aware that it is not known what relationship exists between an increase in an economic indicator and an increase in emissions from a particular category. Another complicating factor is the present energy situation--it is not known what effect the current situation will have on long-term growth.

emissions in six AQCRs (St. Louis, Denver, Washington, D.C., Seattle, Indianapolis, and Boston). These factors represent reductions in emissions resulting from imposition of typical regulations under the SIP process. Power plant emissions are calculated separately from other sources because (1) of the importance of their emissions, (2) different emission reduction ratios must be applied to them, and (3) projections of new power plants are readily available. Obviously, SIP emission limitations vary widely, and thus the factors may over- or underestimate results in some cases. In the interest of alleviating a time-consuming burden, however, EPA offers this technique as a substitute for a detailed source-by-source and detailed category analysis only in those states where time does not permit use of the "preferred" method.

4.1.2.1 Step A - Determine 1970 Emissions - Using emissions summaries, or NEDS data bank, obtain and record 1970 emissions for each pollutant by point and area source category, i.e., fuel combustion, industrial processes, solid waste, transportation, and miscellaneous sources. Show emissions for power plants separate from other fuel combustion sources. Emissions can be recorded in this manner as shown in Table 4-1.

4.1.2.2 Step B - Determine 1975 Power Plant Emissions - Calculate power plant emissions from existing and new plants using data from Steam-Electric Plant Factors, published yearly by the National Coal Association.²

²Steam-Electric Plant Factors. National Coal Association, 1130 Seventeenth St., N.W., Washington, D.C. 20036.

4.1.2.2.1 Power plants existing in 1970 - Multiply 1970 SIP emission factors in Table 4-2 (or more specific factors, if available) to get 1975 controlled emissions. This reduction applies only to those plants that were not controlled to SIP regulations in 1970. For power plants that were under control in 1970, extend 1970 emissions unchanged to 1985.

4.1.2.2.2 New power plants - It is preferable that the state contact electric utility companies directly to obtain projections of new power plants. If time does not permit this, use 1975 projections of new capacity in the latest edition of Steam-Electric Plant Factors. Calculate emissions in 1975 for additional capacity over 1970 using appropriate factors for losses allowed by Federal New Source Performance Standards, or SIP regulations in the event the SIP regulations either take effect earlier or are more stringent than the NSPS.

4.1.2.3 Step C Determine 1975 Emissions from Other Sources - Determine allowable emissions in 1975 for point and area sources (other than power plants and transportation sources) by source category using the emission reduction factors given in Table 4-2. If it is likely that state regulations or those of a local agency within state boundaries would result in values significantly different from those produced by use of the factors in Table 4-2, then the state should use its own regulations or those of the appropriate local agency in determining 1975 emissions. Such regulations should be documented. Since this estimate does not account for growth between 1970 and 1975, the results of using Table 4-2 must be modified by the projected growth in emissions for each source category.

4.1.2.4 Step D - Project Growth Rates for 1970 to 1975 - To obtain emissions for all sources except power plants, multiply emissions determined in Step C

Table 4-2. EMISSION REDUCTION FACTORS^a
(Ratio of 1975 allowable emissions to 1970 emissions)

Source Category	Particulate matter	SO _x	Hc	CO	NO _x
Fuel combustion					
Point sources minus power generation	0.44	0.43	1.0	1.0	1.0
Area sources	0.48	0.57	1.0	1.0	1.0
Power generation sources	0.50	0.43	1.0	1.0	1.0
Industrial processes	0.43	0.37	0.47	0.10	1.0
Solid Waste					
Point sources	0.29	1.0	1.0	0.53	1.0
Area sources	0.28	0.82	0.88	0.88	1.0
Transportation	1.0	1.0	b	b	b
Miscellaneous					
Point sources	1.0	1.0	0.48	1.0	1.0
Area sources	1.0	1.0	1.0	1.0	1.0

^aThese emission reduction factors for 1975 as compared to 1970 are based on a composite of expected and existing conditions and emission control regulations in St. Louis, Denver, Washington, D.C., Seattle, Indianapolis, and Boston. All agencies should develop such factors for conditions in each area under consideration whenever possible. The factors above should be used only when such specific factors cannot be prepared.

^bCalculated by different method; see text.

above by growth factors obtained from available data or BEA projections, determined as follows:*

1. For fuel combustion sources, except power plants (where the method of calculating growth has been previously explained), it is suggested that the growth rate be based on the percent increase in total earnings from 1970 to 1975 for the particular SMSA.
2. For the industrial processes, the growth rate can be based on the percent increase in manufacturing earnings.
3. For solid waste emissions, the growth factor can be based on the percent increase in population for 1970 to 1975.
4. For miscellaneous emissions, the growth factor can be based on the increase in total earnings as was suggested for the category of fuel combustion sources.
5. For particulate matter and SO_x emissions from transportation, the growth factor can be based on the increase in population. These growth factors can be inserted in Column C-1.

4.2 PROJECTING 1985 EMISSIONS

For transportation sources, the following formula may be used to compute 1985 emissions using 1972 baseline data for NO_2 and 1970 baseline data for all other pollutants. (It is not necessary to make a calculation to determine the level of 1975 emissions for transportation sources):

$$Q_{1985} = \sum_{i=1}^I (Q_{base})_i G_i E_i$$

*CO, HC, and NO_x emissions from transportation sources can be calculated to 1985 directly by the method presented in Section 4.2

where Q_{1985} = Projected 1985 emissions

$(Q_{base})_i$ = Baseline emission from source category i.

G_i = Growth factor for source category i.

E_i = Emission factor ratio for source category i.

Project 1985 emissions from 1975 emissions for all source categories other than transportation using the formula:*

$$F_i = C_i (1 + D_i E_i)$$

where: F = 1985 emissions from source category i

D = Growth rate of emissions between 1975 and 1985 for source category i

E = Emission factor adjustment for source category i (applied only to industrial process sources - for all other categories $E_i = 1$)

Growth rates (D in Equation 4-2) for emissions between 1975 and 1985 are the same as those used to project 1975 emissions (see footnote in Section 4.1.1). That is, the percent increase in total earnings projected for 1975 to 1985 may be used to project emissions from fuel combustion; the percent increase in manufacturing earnings may be used for industrial processes; the percent increase in population may be used for solid waste emissions and particulate matter and SO_x emissions from transportation; and the percent increase in total earnings may be used for the miscellaneous category. For power plants, it is again recommended that the state contact electric utility companies directly. If time does not permit this, the percent increase in total earnings projected for 1975 to 1985 may be used to project 1985 power plant emissions since it appears to be most closely related to the

*This formula is not to be used for power plants if actual existing and projected emissions are available.

increased demand for electric power. Add these power plant emissions to the emissions extended unchanged from 1970 to get total 1985 emissions from power plants.

An adjustment will be needed to account for control between 1975 and 1985 of new industrial process sources because of forthcoming new source performance standards. Generally, these standards will be more stringent than limitations presently contained in the SIPs. The adjustment needed to account for future new source performance standards would be the ratio of the estimated percent allowable emissions under the future new source performance standards to the percent allowable emissions under the current SIP control strategy. These ratios, of course, vary widely among industrial categories. Furthermore, EPA has only a rough idea of what the standards will eventually be. It is suggested, therefore, that a composite adjustment factor of 0.40 be used as the "E" value in Equation 4-2 for industrial process sources for each pollutant. Bear in mind that this "E" value applies only to industrial process sources. For other source categories, use $E=1$. Examples of the method of projecting 1985 emissions and air quality, using the "back-up" method of projecting 1975 emissions, are enclosed in Appendix B of these guidelines.

5. INSTRUCTIONS FOR MODELING AIR QUALITY CONCENTRATIONS

5.1 INTRODUCTION

This section of the guideline presents information concerning models recommended for use in predicting 1985 air quality, once 1985 emissions have been calculated. After this air quality prediction has been made, the designation of AQMAs can be made, i.e., those areas that are predicted to exceed the standard can be selected.

5.2 ANALYTICAL TECHNIQUES FOR CARBON MONOXIDE

Once carbon monoxide (CO) emissions have been projected to 1985, using techniques found in Chapter 4 of this document, air quality concentrations for CO can be determined with the aid of the following techniques.

High CO concentrations are observed primarily near areas of high traffic density. "Rollback" models for CO have been criticized for giving undue weight to stationary source CO emissions and to vehicle emissions growth in the suburbs as compared to vehicle emissions growth on streets in the fully developed parts of urban areas where most existing air sampling sites are located. The following model mitigates these problems by giving the most weight (80 per cent) to local traffic near the air sampling station and relatively less weight (20 per cent) to total regional emissions.

The model divides the observed CO concentration into two parts: that attributable to local traffic, and that attributable to the entire urbanized area. Changes in emissions from each of these components are projected, and the 1985 concentration is predicted using modified rollback techniques. The model equations are:

$$F_T = F_L + F_U + b \quad (5-1)$$

$$\frac{F_L}{0.8(B-b)} = \frac{P_L G_L^* E_L + P_H G_H^* E_H}{P_L + P_H} \quad (5-2)$$

$$\frac{F_U}{0.2(B-b)} = \frac{P_L G_L E_L + P_H G_H E_H + P_S G_S E_S}{100\%} \quad (5-3)$$

where: F_T = Total future (1985) CO concentration

F_L = Future concentration attributable to local traffic

F_U = Future concentration attributable to urban emission

b = Background concentration

B = Baseline concentration (measured or estimated)

P_L = Percent emission from light-duty vehicles (gross vehicle weight < 6000 lb)

P_H = Percent emission from other mobile sources (gross vehicle weight > 6000 lb)

P_S = Percent emission from stationary sources

G = Growth factor over the projection period, $G^* \neq G$

E = Expected ratio of 1985 emission to baseline emission for a composite source (Obtained from Table 5-1)

G^* = Growth factor for traffic on local streets near critical air sampling stations.

Equations 5-1, 5-2, and 5-3 may be used to estimate 1985 CO concentrations in those areas that cannot be eliminated by using the initial designation criteria. The information needed to apply the equations is listed as follows:

1. Baseline air quality (b). Second highest 8-hour average, during most recent year at a site where the public has access for at least 8 hours.
2. Background CO concentration (b). Use 1 ppm if data to the contrary are unavailable.

3. Percentage contribution of light- and heavy-duty vehicles and stationary sources to the baseline year emission inventory (same year as air quality data). This information should be computed from the latest emission inventory available locally. If local data are unavailable, the National Emissions Data System (NEDS) data file contains emissions data by county which may be used. The users of equations 5-1, 5-2, and 5-3 must distinguish between two sets of P_L and P_H values for the local traffic and general urban cases: in the calculation of F_L , use the P_L and P_H values used in the application of the initial designation criteria for CO; in the calculation of F_U , use the P_L and P_H values corresponding to the general urban area.
4. Growth rates from past trends for the source categories. Ideally, the growth rates should be based on a direct indicator of emission potential such as vehicle miles, material processed, kilowatts generated, etc. It may be necessary to use an indirect indicator such as the BEA projections of population and economic activity. Growth in population is recommended as a logical choice of estimator of mobile source emissions.
5. Emission factor ratios. Nationwide emission factor ratios for motor vehicles are presented in Table 5-1. If local mobile source emission factors are expected to differ from the national by virtue of transportation controls, unusual vehicle life expectancy, or other reasons, local emission factor ratios may be used. The procedure for calculating composite vehicle emission factors is presented in

Table 5-1. EMISSION FACTOR RATIOS^a

Year	Heavy-duty vehicles	Light-duty vehicles
<u>Carbon monoxide</u>		
1970 ^b	1.00	1.00
1975	0.96	0.59
1980	0.94	0.29
1985	0.93	0.08
<u>Hydrocarbons</u>		
1970 ^b	1.00	1.00
1975	0.92	0.50
1980	0.82	0.25
1985	0.79	0.07

^aRatio of emissions in given year to 1970 base year.

^bFor data bases other than 1970 (such as 1971, 1972, 1973) for CO and HC, interpolate between 1970 and 1975 values.

the publication EPA-450/2-73-003, An Interim Report on Motor Vehicle Emission Estimation.³

The emission factor ratio for stationary sources will depend on the particular source mix in the area and on state regulations for stationary source CO emissions. If such information is unavailable, then the following emission factor ratios may be used:

<u>Source</u>	<u>CO Emission Factor Ratio, 1970-1985</u>
Power plants	1.0
Industry	0.5
Area Sources (stationary)	1.0

The overall stationary source emission factor ratio is calculated from

$$E_{\text{composite}} = \frac{P_{PP} E_{PP} + P_I E_I + P_A E_A}{P_{PP} + P_S + P_A}$$

5.3 RELATING OXIDANT CONCENTRATION TO HYDROCARBON EMISSIONS

Appendix J to 40 CFR Part 51 "Requirements for Preparation, Adoption, and Submittal of Implementation Plans" (published in the August 14, 1971, and republished in the November 25, 1971, Federal Register) presents an estimate of the hydrocarbon emission reduction needed to obtain the NAAQS for photochemical oxidant. This estimate is based on an "envelope curve" that encloses data points for nonmethane hydrocarbon and oxidant concentrations in several cities.

There is evidence to suggest that HC/NO_x ratios should decrease as a result of emission control regulations in force and anticipated. There

³ Kircher, D.S. and Armstrong, D.P. "An Interim Report on Motor Vehicle Emission Estimation," EPA-450/2-73-003, Research Triangle Park, N.C. October 1973.

should also be some oxidant reduction, although the amount of additional reduction cannot be quantified at present. Therefore, Appendix J must be considered a conservative estimate in that it may require more HC reduction than needed.

Appendix J should be used as follows:

1. Project 1985 HC emissions as shown in Steps A through D of Section 4.1.2.1 through 4.1.2.4.

2. Determine the expected emission change by

$$R_{\text{expected}} = \frac{E_{\text{base}} - E_{1985}}{E_{\text{base}}} \times 100\%$$

3. Determine the required percentage hydrocarbons emission reductions using Appendix J and the highest observed 1-hour oxidant concentration during the baseline year.

4. If R required from Step 3 is greater than R expected from Step 2, the area should be designated an AQMA for oxidant.

This will be especially true if R_{expected} is a negative number.

5.4 ANALYTICAL TECHNIQUES FOR OTHER POLLUTANTS--RELATING PROJECTED EMISSIONS TO AIR QUALITY

5.4.1 Proportional Roll-forward Model

Present air quality may be projected to 1985 for pollutants other than oxidants and CO (i.e., air quality may be projected for TSP, SO_2 , and NO_x) using the proportional rollforward model as shown in the following formula.

$$C_{1985} = b + (C_{\text{base}} - b) \frac{Q_{1985}}{Q_{\text{base}}}$$

Where: C_{1985} = projected concentration

b = background concentration

C_{base} = baseline concentration

Q_{1985} = projected emission

Q_{base} = baseline emission

While the proportional rollforward technique is a potential means for selecting which counties or SMSAs to designate as AQMAs, it has several shortcomings which may render it unsuitable, or impossible, to apply. There are:

1. Base year air quality observations are required.
2. The monitoring data must be representative of the area of interest (i.e., a monitor dominated by a single point source or a small number of select sources may result in anomalous predictions).
3. The meteorology occurring during the base period must be similar to that which is of interest during the period being modeled. As a result of these limitations, it may be necessary to designate AQMAs using analytical techniques which:
 - a. Do not require previous air quality observations,
 - b. Take some explicit account, at least in a rough sense, of meteorological differences.

Where the above conditions apply with particular force, it may be appropriate to use the Miller-Holzworth model described in the next section.

5.4.2 Miller-Holzworth Model

The Miller-Holzworth Model can be used only for the calculation of annual averages of suspended particulate matter and sulfur dioxide. The

Miller-Holzworth Model 1-3 for area sources assumes concentrations to be a function of emission density, wind speed, atmospheric mixing depth, and city size. The model implicitly assumes that the atmosphere is slightly unstable (between Turner Stability Classes C and D).⁴ Stability assumptions cannot be varied. The model, as formulated below, estimates the city-wide average concentration for the sampling time of interest. The relationship among average city-wide concentration, emission density, city size, wind speed, and mixing depth is:

$$\bar{X} = 0.011Q \left[3.61H^{0.13} + \frac{800S}{uH} - \frac{(5.5 \times 10^{-5}) uH^{1.26}}{S} \right] \quad (5-4)$$

Where $\bar{X}$ = average city-wide concentration, $\mu\text{g}/\text{m}^3$

Q = emission density, $\text{tons}/\text{yr}-\text{mi}^2$

H = mixing depth, m

S = along-wind distance of the city (miles). When this is not known, assume $S = \sqrt{\text{area}}$. The "area" is the urbanized portion of the city.

u = wind speed, m/sec

In cities in which $1600 S/u > 0.471 H^{1.13}$, mixing depth is unimportant and $\bar{X}$ becomes $\bar{X} = 0.044 Q (1600 S/u)^{0.115}$ (5-5)

The procedure one would use in applying the model would depend on whether air quality data were available, and on the pollutant and sampling time being analyzed.

1. If no air quality data are available

- a. Use emission density estimates obtained as shown in Section 4 of these Guidelines, "Methods of Projecting Emissions" ($\text{tons}/\text{yr}-\text{mi}^2$)

⁴Turner, D.B., "Workbook of Atmospheric Dispersion Estimates." 999-AP-26 (1969).

- b. For annual standards such as the NAAQS for nitrogen dioxide, refer to Figures 1 and 11 in OAP Publication AP-101⁵ showing the mean annual morning mixing depths and wind speeds for the United States. Select the values of "H" and "U" which are appropriate for the area of the country being analyzed. Use these in Equation (5-4) or Equation (5-5)
- c. For short-term (1-hour to 24-hour) standards, refer to Figures 2 and 12, in Reference 3 showing mean winter morning mixing depths and wind speeds. Use the indicated values in Equation (5-4) or Equation (5-5).

2. If air quality data are available

- a. Take emission projections obtained as shown in Section 4 of these Guidelines.
- b. Subtract present emission density from projected emission density.
- c. Apply the Miller-Holzworth Model as described above except use the difference between projected and present emission densities in Equation (5-4) or (5-5) to obtain

$$\Delta \bar{X} = 0.011 \Delta Q \left[3.61 H^{0.13} + \frac{800S}{u H} - \frac{(5.5 \times 10^{-5}) u H^{1.26}}{S} \right] \quad (5-6)$$

or
$$\Delta \bar{X} = 0.011 \Delta Q (1600 S/u)^{0.115} \quad (5-7)$$

- d. Add $\Delta \bar{X}$ to the observed air quality levels

⁵Holzworth, G.C., "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States," OAP Publication AP-101, January 1972.

3. Use of Calibrated Miller-Holzworth Model

Wherever possible, it would be preferable to use a version of the model that has been calibrated with observed data. Figure 1 in Appendix A of the 40 CFR Part 51 is such a version that has been calibrated for annual TSP and SO₂ concentrations in cases where mixing depth is unimportant. Such cases would occur when

$$1600 S/u < 0.471 H^{1.13}$$

In many cases, mixing depth remains relatively unimportant for pollutant travel times greater than $0.471 H^{1.13}$. Thus, if the annual concentration of TSP or SO₂ concentrations is of interest, Figure 1 in Appendix A of 40 CFR Part 51 should be used instead of Equations (5-4), (5-5), (5-6), (5-7).

5.4.3 Estimating Short-Term Concentrations for Sulfur Dioxide and Particulates

It is necessary that the short-term standards for SO₂ and TSP be maintained as well as the annual standards. Two methods may be employed to estimate compliance with short-term standards: rollforward and the log-normal relationship.

5.4.3.1 Rollforward - The proportional model given in Section 5.4.1 may be applied directly to short-term concentrations. The second highest 24-hour or 3-hour concentration* observed in the AQMA entered as C_{base}, and the calculated C₁₉₈₅ is compared with the appropriate short-term standard.

5.4.3.2 Log-Normal - Log-normal model is an empirical relationship developed by Dr. Larsen of EPA. The model allows the estimation of short-term maximum concentrations given the annual average and a characteristic parameter of the

*Short-term standards are not to be exceeded more than once per year. Thus, it is the second highest value that must meet NAAQS.

concentration distribution called the Geometric Standard Deviation (GSD). Table 5-2 is taken directly from R. I. Larsen's A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards, AP-89. Using this table, the peak concentration may be calculated from the annual average provided the GSD is known. The GSD is routinely calculated for air quality data in the SAROAD data bank.

5.5 COMPARISON OF PROJECTED AIR QUALITY WITH NAAQS

After air quality concentrations have been projected to 1985, a comparison to the NAAQS presented in Section 2.8 can be made. If the projected air quality of an area exceeds a NAAQS, the area should be designated an AQMA for that pollutant; conversely, if the projected air quality does not exceed a NAAQS, the area does not have to be designated as an AQMA for that pollutant.

NOTE: Examples of the method of projecting 1985 emissions and air quality using the "back-up" method of projecting 1975 emissions are enclosed in Appendix B of these guidelines.

Table 5-2. RATIO OF EXPECTED ANNUAL MAXIMUM POLLUTANT CONCENTRATION TO ARITHMETIC MEAN CONCENTRATION FOR VARIOUS AVERAGING TIMES AND STANDARD GEOMETRIC DEVIATIONS

Standard geometric deviation for averaging times of:								Ratio of annual maximum concentration to mean concentration for averaging times of:							
1 sec	5 min	1 hr	3 hr	8 hr	1 day	4 days	1 mo	1 sec	5 min	1 hr	3 hr	8 hr	1 day	4 days	1 mo
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.07	1.06	1.05	1.05	1.04	1.04	1.04	1.03	1.44	1.27	1.20	1.17	1.15	1.12	1.09	1.04
1.14	1.11	1.10	1.09	1.09	1.08	1.07	1.05	2.04	1.59	1.43	1.37	1.31	1.25	1.18	1.08
1.21	1.17	1.15	1.14	1.13	1.12	1.10	1.08	2.83	1.97	1.69	1.57	1.48	1.38	1.27	1.12
1.29	1.23	1.20	1.19	1.17	1.16	1.14	1.10	3.86	2.42	1.97	1.80	1.66	1.52	1.36	1.16
1.36	1.29	1.25	1.23	1.22	1.20	1.17	1.12	5.18	2.93	2.28	2.05	1.86	1.67	1.46	1.20
1.44	1.34	1.30	1.28	1.26	1.24	1.20	1.15	6.85	3.51	2.63	2.31	2.06	1.82	1.56	1.24
1.51	1.40	1.35	1.32	1.30	1.27	1.24	1.17	8.94	4.18	3.00	2.60	2.28	1.98	1.65	1.28
1.59	1.46	1.40	1.37	1.34	1.31	1.27	1.19	11.53	4.93	3.41	2.90	2.51	2.14	1.75	1.31
1.67	1.52	1.45	1.42	1.39	1.35	1.30	1.21	14.69	5.77	3.84	3.22	2.75	2.31	1.85	1.35
1.75	1.58	1.50	1.46	1.43	1.39	1.33	1.24	18.53	6.71	4.32	3.56	3.00	2.48	1.95	1.38
1.83	1.64	1.55	1.51	1.47	1.42	1.36	1.26	23.14	7.76	4.82	3.92	3.26	2.65	2.05	1.42
1.91	1.70	1.60	1.55	1.51	1.46	1.39	1.28	28.65	8.92	5.37	4.30	3.53	2.84	2.15	1.45
1.99	1.76	1.65	1.60	1.55	1.50	1.42	1.30	35.16	10.19	5.95	4.70	3.81	3.02	2.26	1.48
2.08	1.82	1.70	1.64	1.59	1.53	1.45	1.32	42.83	11.58	6.56	5.12	4.10	3.21	2.36	1.52
2.16	1.88	1.75	1.69	1.63	1.57	1.48	1.34	51.78	13.11	7.21	5.55	4.40	3.40	2.46	1.55
2.25	1.94	1.80	1.74	1.68	1.61	1.51	1.36	62.18	14.76	7.90	6.01	4.71	3.60	2.57	1.58
2.34	2.00	1.85	1.78	1.72	1.64	1.54	1.38	74.18	16.56	8.62	6.49	5.03	3.80	2.67	1.61
2.42	2.06	1.90	1.83	1.76	1.68	1.57	1.40	87.96	18.50	9.39	6.98	5.36	4.00	2.77	1.64
2.51	2.12	1.95	1.87	1.80	1.71	1.60	1.42	103.70	20.59	10.19	7.49	5.70	4.21	2.88	1.67
2.60	2.19	2.00	1.92	1.84	1.75	1.63	1.44	121.61	22.83	11.03	8.03	6.04	4.42	2.98	1.70
2.69	2.25	2.05	1.96	1.88	1.78	1.66	1.46	141.88	25.24	11.91	8.58	6.40	4.64	3.09	1.73
2.78	2.31	2.10	2.00	1.92	1.82	1.69	1.47	164.73	27.81	12.83	9.15	6.76	4.85	3.19	1.75
2.87	2.37	2.15	2.05	1.96	1.85	1.72	1.49	190.39	30.55	13.78	9.74	7.14	5.07	3.30	1.78
2.97	2.43	2.20	2.09	2.00	1.89	1.74	1.51	219.09	33.47	14.78	10.34	7.52	5.29	3.40	1.81
3.06	2.50	2.25	2.14	2.04	1.92	1.77	1.53	251.07	36.56	15.81	10.97	7.9	5.52	3.51	1.83
3.15	2.56	2.30	2.18	2.08	1.96	1.80	1.55	286.61	39.84	16.89	11.61	8.30	5.75	3.61	1.86
3.25	2.62	2.35	2.23	2.12	1.99	1.83	1.56	325.94	43.31	18.00	12.27	8.71	5.98	3.72	1.88
3.34	2.69	2.40	2.27	2.16	2.03	1.85	1.58	369.37	46.97	19.15	12.94	9.12	6.21	3.82	1.91
3.44	2.75	2.45	2.32	2.20	2.06	1.88	1.60	417.15	50.82	20.34	13.64	9.54	6.44	3.93	1.93
3.54	2.81	2.50	2.36	2.24	2.09	1.91	1.62	469.60	54.88	21.57	14.35	9.97	6.68	4.03	1.96
3.64	2.88	2.55	2.41	2.27	2.13	1.93	1.63	527.00	59.14	22.84	15.07	10.40	6.92	4.13	1.98
3.74	2.94	2.60	2.45	2.31	2.16	1.96	1.65	599.67	63.60	24.14	15.82	10.84	7.16	4.24	2.00
3.83	3.00	2.65	2.49	2.35	2.19	1.99	1.67	657.92	68.28	25.49	16.58	11.28	7.40	4.34	2.03
3.93	3.07	2.70	2.54	2.39	2.23	2.01	1.68	732.07	73.17	26.87	17.35	11.74	7.64	4.44	2.05
4.04	3.13	2.75	2.58	2.43	2.26	2.04	1.70	812.47	78.28	28.29	18.14	12.20	7.89	4.55	2.07
4.14	3.20	2.80	2.63	2.47	2.29	2.07	1.71	899.45	83.61	29.75	18.95	12.66	8.13	4.65	2.09
4.24	3.26	2.85	2.67	2.51	2.33	2.09	1.73	993.34	89.16	31.24	19.77	13.13	8.38	4.75	2.11
4.34	3.33	2.90	2.71	2.55	2.36	2.12	1.75	1094.51	94.94	32.78	20.60	13.61	8.63	4.86	2.13
4.45	3.39	2.95	2.76	2.59	2.39	2.14	1.76	1203.31	100.94	34.35	21.45	14.09	8.88	4.96	2.16
4.55	3.46	3.00	2.80	2.62	2.42	2.17	1.78	1320.11	107.17	35.95	22.32	14.58	9.13	5.06	2.18
4.66	3.52	3.05	2.84	2.66	2.46	2.20	1.79	1445.27	113.64	37.60	23.20	15.07	9.38	5.16	2.20
4.76	3.59	3.10	2.89	2.70	2.49	2.22	1.81	1579.16	120.34	39.28	24.09	15.57	9.64	5.26	2.22
4.87	3.65	3.15	2.93	2.74	2.52	2.25	1.82	1722.17	127.28	40.99	25.00	16.07	9.89	5.36	2.24
4.97	3.72	3.20	2.98	2.78	2.55	2.27	1.84	1874.68	134.46	42.74	25.92	16.57	10.15	5.46	2.25

Table 5-2 (Continued). RATIO OF EXPECTED ANNUAL MAXIMUM POLLUTANT CONCENTRATION TO ARITHMETIC MEAN CONCENTRATION FOR VARIOUS AVERAGING TIMES AND STANDARD GEOMETRIC DEVIATIONS

Standard geometric deviation for averaging times of:								Ratio of annual maximum concentration to mean concentration for averaging times of:							
1 sec	5 min	1 hr	3 hr	8 hr	1 day	4 days	1 mo	1 sec	5 min	1 hr	3 hr	8 hr	1 day	4 days	1 mo
5.08	3.78	3.25	3.02	2.81	2.59	2.30	1.85	2037.07	141.87	44.53	26.85	17.09	10.40	5.56	2.27
5.19	3.85	3.30	3.06	2.85	2.62	2.32	1.87	2209.73	149.53	46.35	27.79	17.60	10.66	5.66	2.29
5.30	3.91	3.35	3.11	2.89	2.65	2.35	1.88	2393.06	157.43	48.20	28.75	18.12	10.92	5.76	2.31
5.41	3.98	3.40	3.15	2.93	2.68	2.37	1.90	2587.45	165.58	50.09	29.72	18.65	11.18	5.86	2.33
5.52	4.05	3.45	3.19	2.97	2.71	2.39	1.91	2793.31	173.97	52.01	30.71	19.17	11.44	5.96	2.35
5.63	4.11	3.50	3.24	3.00	2.75	2.42	1.93	3011.02	182.61	53.96	31.70	19.71	11.70	6.05	2.36
5.74	4.18	3.55	3.28	3.04	2.78	2.44	1.94	3241.01	191.50	55.95	32.71	20.24	11.96	6.15	2.38
5.85	4.24	3.60	3.32	3.08	2.81	2.47	1.95	3483.66	200.63	57.97	33.72	20.78	12.22	6.25	2.40
5.96	4.31	3.65	3.37	3.12	2.84	2.49	1.97	3739.39	210.02	60.02	34.75	21.32	12.48	6.34	2.41
6.08	4.38	3.70	3.41	3.15	2.87	2.52	1.98	4008.61	219.65	62.11	35.79	21.87	12.74	6.44	2.43
6.19	4.44	3.75	3.45	3.19	2.90	2.54	2.00	4291.72	229.54	64.22	36.84	22.42	13.00	6.53	2.45
6.30	4.51	3.80	3.50	3.23	2.93	2.56	2.01	4589.13	239.67	66.37	37.90	22.97	13.26	6.63	2.46
6.42	4.58	3.85	3.54	3.27	2.96	2.59	2.02	4901.25	250.06	68.55	38.97	23.53	13.53	6.72	2.48
6.53	4.65	3.90	3.58	3.30	3.00	2.61	2.04	5228.49	260.70	70.75	40.05	24.09	13.79	6.82	2.49
6.65	4.71	3.95	3.63	3.34	3.03	2.63	2.05	5571.26	271.59	72.99	41.14	24.65	14.05	6.91	2.51

6. PROJECTIONS OF DEMOGRAPHIC AND ECONOMIC INDICATORS BY SMSA

Table 6-1 presents the national projections of demographic and economic indicators for the United States. These projections were taken directly from Population and Economic Activity in the United States and Standard Metropolitan Statistical Areas - Historical and Projected--1950-2020, prepared by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) in July, 1972.⁶ Because of the large number of SMSAs, the major users of this document (state air pollution control agencies and EPA Regional Offices) received copies of the projections for the SMSAs located in their particular geographic areas of interest. If the reader desires a copy of the projections for particular SMSAs, he can request these from the representative responsible for matters concerning maintenance of air quality standards in the appropriate EPA Regional Office or the appropriate state air pollution control agency. The BEA projection report is also located in U.S. Government depository libraries under the GPO number EP 1.2:P81/950-020.

This chapter also contains a list of states and the names of the SMSAs located in each state (this list is of the SMSAs as of January 7, 1972, not the most current list), and a list of the SMSAs and the counties which are contained within each SMSA (again, these are the SMSAs of January 7, 1972)

⁶Population and Economic Activity in the United States and Standard Metropolitan Statistical Areas - Historical and Projected 1950-2020. The U.S. Department of Commerce, Social and Economic Statistics Administration, Bureau of Economic Analysis, Washington, D.C. GPO Number EP 1.2:P81/950-020. July 1972. 543 pages (may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402).

UNITED STATES TOTAL

Table 6-1.

POPULATION, EMPLOYMENT, PERSONAL INCOME, AND EARNINGS BY INDUSTRY, HISTORICAL AND PROJECTED, SELECTED YEARS, 1950 - 2020

	1950	1959	1968	1970	1975	1980	1985	1990	2000	2020
POPULATION, MICHIGAN	151,871,000	177,125,000	189,793,000	203,773,000	218,627,700	236,208,000	251,155,700	266,753,000	306,782,000	369,013,000
PER CAPITA INCOME, 1947-50	2,008	2,441	3,106	3,666	4,165	4,765	5,420	6,166	6,289	10,262
PER CAPITA INCOME RELATIVE (1950=100)	1.00	1.20	1.50	1.60	1.80	2.00	2.20	2.40	2.40	5.10
TOTAL EMPLOYMENT	57,676,912	66,372,449	78,013,115	87,013,115	96,013,115	105,013,115	114,013,115	123,013,115	132,013,115	141,013,115
EMPLOYMENT/POPULATION RATIO	.38	.37	.41	.43	.44	.45	.46	.47	.43	.38
IN THOUSANDS OF 1967 \$										
TOTAL PERSONAL INCOME *	313,569,016	432,349,206	680,045,911	706,334,632	897,399,600	1,115,898,300	1,362,435,800	1,663,339,300	2,052,488,500	3,691,073,000
TOTAL EARNINGS	256,747,759	355,766,804	529,653,952	560,622,337	714,962,500	881,560,000	1,070,861,400	1,300,630,200	1,670,734,600	2,937,621,000
AGRICULTURE, FORESTRY & FISHERIES	23,497,266	17,042,354	18,413,005	18,579,767	19,940,800	19,855,300	20,706,000	21,588,000	25,443,300	44,447,500
MINING	23,111,288	18,011,117	18,761,117	18,761,117	19,600,500	19,600,500	20,236,500	21,055,500	24,788,000	43,241,000
MANUFACTURING	465,635	551,023	281,624	273,623	331,700	406,100	485,300	533,100	709,300	1,218,100
CONTRACT CONSTRUCTION	9,145,232	9,145,232	5,273,946	9,145,232	6,364,700	7,284,300	7,964,800	8,713,300	10,210,800	16,013,500
TRANSPORTATION, COMMUNICATIONS, UTILITIES	2,284,552	1,260,241	1,182,615	1,439,282	1,504,400	1,755,000	1,877,800	1,994,000	2,233,400	2,606,100
GOVERNMENT	1,734,789	2,357,009	2,443,220	2,532,123	2,681,100	3,210,200	3,652,200	3,771,500	4,362,100	5,775,200
NONMETALLIC EXCEPT FUELS	562,403	685,796	923,888	908,634	1,122,900	1,348,800	1,550,000	1,781,300	2,442,500	4,581,000
PRIMARY METALS	15,083,087	21,052,040	31,076,705	34,199,358	43,281,300	52,486,000	61,741,700	77,410,200	117,117,000	256,400,000
STEEL	7,681,739	10,255,073	15,040,036	15,040,036	20,101,000	24,079,300	28,586,400	33,409,700	42,557,000	1,020,457,000
NONFERROUS METALS	8,050,358	10,797,000	12,576,669	13,079,322	15,015,000	17,134,700	19,245,300	21,625,200	28,070,900	47,001,000
TEXTILE MILLS	5,500,232	4,500,000	5,380,174	5,380,174	6,524,500	7,616,000	8,484,500	9,688,000	12,883,300	22,501,000
APPAREL & OTHER FABRIC PRODUCTS	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000
LUMBER PRODUCTS & FURNITURE	5,223,319	5,223,319	5,223,319	5,223,319	5,223,319	5,223,319	5,223,319	5,223,319	5,223,319	5,223,319
PAPER & ALLIED PRODUCTS	3,894,717	3,894,717	3,894,717	3,894,717	3,894,717	3,894,717	3,894,717	3,894,717	3,894,717	3,894,717
PRINTING & PUBLISHING	2,237,267	2,237,267	2,237,267	2,237,267	2,237,267	2,237,267	2,237,267	2,237,267	2,237,267	2,237,267
CHEMICALS & ALLIED PRODUCTS	1,653,512	1,653,512	1,653,512	1,653,512	1,653,512	1,653,512	1,653,512	1,653,512	1,653,512	1,653,512
PETROLEUM REFINING	6,696,935	6,696,935	6,696,935	6,696,935	6,696,935	6,696,935	6,696,935	6,696,935	6,696,935	6,696,935
PRIMARY METALS	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232
FABRICATED METALS & CRONANCE	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232	9,145,232
MACHINERY, EXCLUDING ELECTRICAL	9,099,387	9,099,387	9,099,387	9,099,387	9,099,387	9,099,387	9,099,387	9,099,387	9,099,387	9,099,387
ELECTRICAL MACHINERY & SUPPLIES	10,653,431	10,653,431	10,653,431	10,653,431	10,653,431	10,653,431	10,653,431	10,653,431	10,653,431	10,653,431
TOTAL MACHINERY (1950 ONLY)	9,394,820	9,394,820	9,394,820	9,394,820	9,394,820	9,394,820	9,394,820	9,394,820	9,394,820	9,394,820
MOTOR VEHICLES & EQUIPMENT	3,187,500	3,187,500	3,187,500	3,187,500	3,187,500	3,187,500	3,187,500	3,187,500	3,187,500	3,187,500
OTHER MANUFACTURING	2,629,937	2,629,937	2,629,937	2,629,937	2,629,937	2,629,937	2,629,937	2,629,937	2,629,937	2,629,937
TRANSPORTATION, COMMUNICATIONS, UTILITIES	21,131,028	27,392,039	36,582,940	39,733,207	47,668,400	56,816,900	67,436,000	80,039,300	116,398,000	241,305,600
WHOLESALE & RETAIL TRADE	48,039,614	63,099,621	87,077,150	93,266,904	119,099,400	148,563,600	180,821,400	220,080,800	335,481,200	746,447,800
FINANCE, INSURANCE & REAL ESTATE	10,911,234	14,109,611	27,739,804	29,380,297	36,776,100	45,110,800	54,385,000	65,565,700	98,040,200	212,159,200
SERVICES	28,806,364	45,246,956	77,245,516	85,174,919	111,912,700	145,219,500	182,753,700	229,968,500	368,579,200	876,784,700
GOVERNMENT	29,818,398	50,221,040	90,076,855	99,104,684	127,657,600	165,229,300	206,601,000	256,331,700	406,360,000	932,716,100
CIVILIAN GOVERNMENT	23,930,863	40,409,803	74,970,068	84,120,212	110,335,800	146,378,400	185,024,700	233,673,700	374,582,200	879,252,900
ARMED FORCES	5,887,535	9,811,240	15,106,787	14,984,472	17,321,800	18,850,900	21,576,300	22,658,000	31,777,800	53,463,200

Table 6-2 lists SMSAs alphabetically by states. Table 6-3 lists the Standard Metropolitan Statistical Areas and indicates the constituent counties as of January 7, 1972. The projections of demographic and economic indicators, done by the Bureau of Economic Analysis (BEA), Department of Commerce, were made on the basis of SMSAs as they were defined as of January 7, 1972.

The following SMSA designation differs from the official designation of the Office of Management and Budget in one respect: SMSAs in the New England States are officially defined on a township, rather than a county basis; BEA projections for these New England SMSAs, however, are based upon geographic areas which are defined on a whole-county basis. Thus, for example, the Fitchburg-Leominster, Mass. SMSA and the Worcester, Mass., SMSA are combined in the BEA projections into one area, Worcester County, even though the Fitchburg-Leominster SMSA officially includes several townships from another county (Middlesex), and portions of Worcester County are not officially located in either SMSA.

Table 6-2. SMSAs LISTED ALPHABETICALLY BY STATE

INDEX OF TABLES					
SMSA'S LISTED ALPHABETICALLY BY STATE					
STATE	B.E.A SMSA CODE AND TITLE	PAGE	STATE	B.E.A SMSA CODE AND TITLE	PAGE
ALABAMA	323 BIRMINGHAM, ALA.	72	CONNECTICUT	930 BRIDGEPORT-NORWALK-STAMFORD, CONN.	80
	343 COLUMBUS, GA.-ALA.	118		932 HARTFORD-NEW BRITAIN, CONN.	202
	555 FLORENCE, ALA.	104		931 NEW HAVEN-WATERBURY-MERIDEN, CONN.	314
	370 GADSDEN, ALA.	178		933 NORWICH-GROTON-NEW LONDON, CONN.	326
	384 HUNTSVILLE, ALA.	210	DELAWARE		
	424 MOBILE, ALA.	298		521 WILMINGTON, DEL.-N.J.-MD.	510
	426 MONTGOMERY, ALA.	304	D. C.		
	508 TUSCALOOSA, ALA.	482		513 WASHINGTON, D.C.-MD.-VA.	494
ALASKA			FLORIDA		
	531 ANCHORAGE, ALASKA	36		553 DAYTONA BEACH, FLA.	130
ARIZONA				365 FORT LAUDERDALE-HOLLYWOOD, FLA.	166
	450 PHOENIX, ARIZ.	354		556 FORT MYERS, FLA.	168
ARKANSAS				540 GAINESVILLE, FLA.	180
	506 TUCSON, ARIZ.	478		388 JACKSONVILLE, FLA.	218
CALIFORNIA				559 LAKELAND-WINTER HAVEN, FLA.	242
	366 FORT SMITH, ARK.-OKLA.	170		571 MELBOURNE-TITUSVILLE-COCOA, FLA.	286
	407 LITTLE ROCK-NORTH LITTLE ROCK, ARK.	262		420 MIAMI, FLA.	290
	418 MEMPHIS, TENN.-ARK.	289		444 ORLANDO, FLA.	336
	451 PINE BLUFF, ARK.	356		447 PENSACULA, FLA.	346
	502 TEXARKANA, TEX.-ARK.	470		567 SARASOTA, FLA.	426
COLORADO				499 TALLAHASSEE, FLA.	464
	308 ANAHEIM-SANTA ANA-GARDEN GROVE, CALIF.	34		500 TAMPA-ST. PETERSBURG, FLA.	466
	316 BAKERSFIELD, CALIF.	54		516 WEST PALM BEACH, FLA.	498
	369 FRESNO, CALIF.	176	GEORGIA		
	409 LOS ANGELES-LONG BEACH, CALIF.	268		302 ALBANY, GA.	20
	542 MCKEESPORT, CALIF.	300		312 ATLANTA, GA.	48
	445 OXNARD-SIMI VALLEY-VENTURA, CALIF.	340		314 AUGUSTA, GA.-S.C.	50
	476 RIVERSIDE-SAN BERNARDINO-ONTARIO, CALIF.	386		337 CHATTANOOGA, TENN.-GA.	102
	468 SACRAMENTO, CALIF.	396		343 COLUMBUS, GA.-ALA.	218
	533 SALINAS-SEASIDE-MONTEREY, CALIF.	406		414 MACON, GA.	276
	477 SAN DIEGO, CALIF.	414		482 SAVANNAH, GA.	428
	478 SAN FRANCISCO-OAKLAND, CALIF.	416	HAWAII		
	479 SAN JOSE, CALIF.	418		381 HONOLULU, HAWAII	204
	481 SANTA BARBARA-SANTA MARIA-LONPOC, CALIF.	420	IDAHO		
	565 SANTA CRUZ, CALIF.	422		325 BOISE CITY, IDAHO	76
	546 SANTA ROSA, CALIF.	424	ILLINOIS		
	496 STOCKTON, CALIF.	458		324 BLOOMINGTON-NORMAL, ILL.	74
	511 VALLEJO-FAIRFIELD-NAPA, CALIF.	488			

Table 6-2 (Continued).

STATE	B.E.A SMSA CODE AND TITLE	PAGE	STATE	B.E.A SMSA CODE AND TITLE	PAGE
ILLINOIS	CONTINUED		LOUISIANA	CONTINUED	
333	CHAMPAIGN-URBANA, ILL.	94	485	SHREVEPORT, LA.	436
338	CHICAGO, ILL.	106			
347	DAVENPORT-ROCK ISLAND-MOLINE, IOWA-ILL.	126			
349	DECATUR, ILL.	132			
448	PEORIA, ILL.	348	MAINE		
487	ROCKFORD, ILL.	394	940	LEWISTON-AUBURN, MAINE	254
471	ST. LOUIS, MO.-ILL.	402	939	PORTLAND-SOUTH PORTLAND, MAINE	362
490	SPRINGFIELD, ILL.	448			
INDIANA					
309	ANDERSON, IND.	38	MARYLAND		
339	CINCINNATI, OHIO-KY.-IND.	108	317	BALTIMORE, MD.	56
359	EVANSVILLE, IND.-KY.	154	513	WASHINGTON, D.C.-MD.-VA.	494
367	FORT WAYNE, IND.	172	521	WILMINGTON, DEL.-N.J.-MD.	510
372	GARY-HAMMOND-EAST CHICAGO, IND.	184			
385	INDIANAPOLIS, IND.	212			
529	LAFAYETTE-WEST LAFAYETTE, IND.	238	MASSACHUSETTS		
410	LOUISVILLE, KY.-IND.	270	934	BOSTON, MASS.	78
427	MUNCIE, IND.	304	935	FALL RIVER-NEW BEDFORD, MASS.	156
488	SOUTH BEND, IND.	442	936	PITTSFIELD, MASS.	360
501	TERRE HAUTE, IND.	468	937	SPRINGFIELD-CHICOPEE-HOLYOKE, MASS.	454
			938	WORCESTER-PITCHBURG-LEOMINSTER, MASS.	514
IOWA					
332	CEDAR RAPIDS, IOWA	92			
347	DAVENPORT-ROCK ISLAND-MOLINE, IOWA-ILL.	126	MICHIGAN		
351	DES MOINES, IOWA	136	310	ANN ARBOR, MICH.	40
353	DUBUQUE, IOWA	140	552	BATTLE CREEK, MICH.	60
443	OMAHA, NEBR.-IOWA	334	319	BAY CITY, MICH.	62
486	SIOUX CITY, IOWA-NEBR.	438	352	DETROIT, MICH.	138
515	WATERLOO, IOWA	496	364	FLINT, MICH.	182
			373	GRAND RAPIDS, MICH.	186
KANSAS			386	JACKSON, MICH.	214
392	KANSAS CITY, MO.-KANS.	226	391	KALAMAZOO, MICH.	226
504	TOPEKA, KANS.	474	398	LANSING-EAST LANSING, MICH.	246
518	WICHITA, KANS.	502	428	MUSKOGON-MUSKOGON HEIGHTS, MICH.	308
			469	SAGINAW, MICH.	398
			503	TOLEDO, OHIO-MICH.	472
KENTUCKY					
339	CINCINNATI, OHIO-KY.-IND.	108	MINNESOTA		
359	EVANSVILLE, IND.-KY.	154	354	DULUTH-SUPERIOR, MINN.-WIS.	142
383	HUNTINGTON-ASHLAND, W.VA.-KY.-OHIO	208	361	FARGO-MOOREHEAD, N.DAK.-MINN.	158
404	LEXINGTON, KY.	256	423	MINNEAPOLIS-ST. PAUL, MINN.	276
410	LOUISVILLE, KY.-IND.	270	545	ROCHESTER, MINN.	390
543	OWENSBORO, KY.	338			
LOUISIANA			MISSISSIPPI		
551	ALEXANDRIA, LA.	26	535	BILLOXI-GULFPORT, MISS.	68
318	BATON ROUGE, LA.	58	387	JACKSON, MISS.	216
395	LAFAYETTE, LA.	236			
398	LAKE CHARLES, LA.	240	MISSOURI		
428	MONROE, LA.	302	539	COLUMBIA, MO.	114
434	NEW ORLEANS, LA.	316			

Table 6-2 (Continued).

STATE	B.E.A SMSA CODE AND TITLE	PAGE	STATE	B.E.A SMSA CODE AND TITLE	PAGE
MISSOURI	CONTINUED		NEW YORK	CONTINUED	
392	KANSAS CITY, MO.-KANS.	226	563	POUGHKEEPSIE, N.Y.	366
470	ST. JOSEPH, MO.	400	486	ROCHESTER, N.Y.	392
471	ST. LOUIS, MO.-ILL.	402	497	SYRACUSE, N.Y.	460
491	SPRINGFIELD, MO.	450	510	UTICA-ROME, N.Y.	486
MONTANA			NORTH CAROLINA		
321	BILLINGS, MONT.	66	311	ASHEVILLE, N.C.	44
374	GREAT FALLS, MONT.	190	336	CHARLOTTE, N.C.	100
NEBRASKA			355	DURHAM, N.C.	144
406	LINCOLN, NEBR.	260	362	PAYETTEVILLE, N.C.	160
443	OMAHA, NEBR.-IOWA	334	557	GASTONIA, N.C.	186
486	SIOUX CITY, IOWA-NEBR.	438	376	GREENSBORO-WINSTON-SALEM-HIGH POINT, N.C.	194
NEVADA			481	RALEIGH, N.C.	376
400	LAS VEGAS, NEV.	290	522	WILMINGTON, N.C.	512
463	RENO, NEV.	380	NORTH DAKOTA		
NEW HAMPSHIRE			361	FARGO-MOOREHEAD, N.DAK.-MINN.	198
941	MANGHESTER, N.H.	280	OHIO		
NEW JERSEY			301	AKRON, OHIO	18
305	ALLENTOWN-BETHLEHEM-EASTON, PA.-N.J.	28	331	CANTON, OHIO	90
313	ATLANTIC CITY, N.J.	48	339	CINCINNATI, OHIO-KY.-IND.	108
389	JERSEY CITY, N.J.	220	340	CLEVELAND, OHIO	110
560	LONG BRANCH-ASBURY PARK, N.J.	264	346	COLUMBUS, OHIO	120
561	NEW BRUNSWICK-PERTH AMBOY-SAYREVILLE, N.J.	312	348	DAYTON, OHIO	128
436	NEWARK, N.J.	320	379	HAMILTON-MIDDLETOWN, OHIO	198
448	PATERSON-CLIFTON-PASSAIC, N.J.	344	383	HUNTINGTON-ASHLAND, N.VA.-KY.-OHIO	208
449	PHILADELPHIA, PA.-N.J.	352	405	LIMA, OHIO	258
505	TRENTON, N.J.	476	408	LORAIN-ELYRIA, OHIO	266
536	VINELAND-MILLVILLE-BRIDGETON, N.J.	490	530	MANSFIELD, OHIO	282
521	WILMINGTON, DEL.-N.J.-MD.	510	562	PARKERSBURG-MAHLETTA, N.VA.-OHIO	342
NEW MEXICO			492	SPRINGFIELD, OHIO	452
304	ALBUQUERQUE, N.MEX.	24	495	STUEBENVILLE-WEIRTON, OHIO-W.VA.	456
NEW YORK			503	TOLEDO, OHIO-MICH.	472
303	ALBANY-SCHENECTADY-TROY, N.Y.	22	517	WHEELING, W.VA.-OHIO	500
322	BINGHAMTON, N.Y.-PA.	70	526	YOUNGSTOWN-BARREN, OHIO	520
330	BUFFALO, N.Y.	86	OKLAHOMA		
554	ELMIRA, N.Y.	148	366	FORT SMITH, ARK.-OKLA.	170
435	NEW YORK, N.Y.	318	402	LAWTON, OKLA.	452
			442	OKLAHOMA CITY, OKLA.	352
			507	TULSA, OKLA.	480
			OREGON		
			356	EUGENE-SPRINGFIELD, OREG.	152
			456	PORTLAND, OREG.-WASH.	184
			472	SALEM, OREG.	404

Table 6-2 (Continued).

STATE	B.E.A SMSA CODE AND TITLE	PAGE	STATE	B.E.A SMSA CODE AND TITLE	PAGE
PENNSYLVANIA			TEXAS	CONTINUED	
305	ALLENTON-BETHLEHEM-EASTON, PA.-N.J.	28	421	MIDLAND, TEX.	292
306	ALTOONA, PA.	30	440	ODESSA, TEX.	328
322	BINGHAMTON, N.Y.-PA.	70	474	SAN ANGELO, TEX.	410
357	ERIE, PA.	150	475	SAN ANTONIO, TEX.	412
379	HARRISBURG, PA.	200	534	SHERMAN-DENISON, TEX.	434
390	JOHNSTOWN, PA.	222	502	TEXARKANA, TEX.-ARK.	470
397	LANCASTER, PA.	244	509	TYLER, TEX.	484
449	PHILADELPHIA, PA.-N.J.	352	512	WACO, TEX.	492
452	PITTSBURGH, PA.	359	519	WICHITA FALLS, TEX.	504
462	READING, PA.	378			
483	SCRANTON, PA.	430	UTAH		
520	WILKES-BARRE-HAZLETON, PA.	506	441	OGDEN, UTAH	330
569	WILLIAMSPORT, PA.	508	458	PROVO-OREM, UTAH	370
525	YORK, PA.	518	473	SALT LAKE CITY, UTAH	408
RHODE ISLAND			VERMONT		
942	PROVIDENCE-PAWTUCKET-WARWICK, R.I.	368	527	BURLINGTON, VT.	88
SOUTH CAROLINA			VIRGINIA		
314	AUGUSTA, GA.-S.C.	50	413	LYNCHBURG, VA.	274
334	CHARLESTON, S.C.	96	437	NEWPORT NEWS-HAMPTON, VA.	322
342	COLUMBIA, S.C.	116	438	NORFOLK-PORTSMOUTH, VA.	324
377	GREENVILLE, S.C.	196	544	PETERSBURG-HUPEWELL, VA.	350
568	SPARTANBURG, S.C.	444	464	RICHMUND, VA.	384
SOUTH DAKOTA			465	ROANOKE, VA.	387
487	SIOUX FALLS, S.DAK.	440	513	WASHINGTON, D.C.-MD.-VA.	516
TENNESSEE			WASHINGTON		
337	CHATTANOOGA, TENN.-GA.	102	456	PORTLAND, OREG.-WASH.	364
394	KNOXVILLE, TENN.	232	584	RICHLAND-KENNEWICK, WASH.	382
418	MEMPHIS, TENN.-ARK.	288	484	SEATTLE-EVERETT, WASH.	432
429	NASHVILLE, TENN.	310	489	SPOKANE, WASH.	446
498	NASHVILLE, TENN.	310	498	TACOMA, WASH.	462
570	NASHVILLE, TENN.	310	570	YAKIMA, WASH.	516
TEXAS			WEST VIRGINIA		
300	ARILENE, TEX.	16	335	CHARLESTON, W.VA.	98
307	AMARILLO, TEX.	32	383	HUNTINGTON-ASHLAND, W.VA.-KY.-OHIO	208
315	AUSTIN, TEX.	52	562	PARKERSBURG-MARIETTA, W.VA.-OHIO	342
320	BEAUMONT-PHIL ARTHUR-ORANGE, TEX.	64	495	STUBENVILLE-WEIRTON, OHIO-W.VA.	456
329	BROWNSVILLE-HARLINGEN-SAN BENITO, TEX.	82	517	WHEELING, W.VA.-OHIO	500
538	BRYAN-COLLEGE STATION, TEX.	84			
345	CORPUS CHRISTI, TEX.	122			
346	DALLAS, TEX.	124			
356	EL PASO, TEX.	146			
368	FORT WORTH, TEX.	174			
371	GALVESTON-TEXAS CITY, TEX.	182			
382	HOLSTON, TEX.	206			
558	KILLEEN-TEMPLE, TEX.	230			
399	LAREDO, TEX.	248			
412	LUBBOCK, TEX.	272			
532	MCCALLEN-PHARR-EDINBURG, TEX.	284			
			WISCONSIN		
			537	APPLETON-OSHKOSH, WIS.	42
			354	DULUTH-SUPERIOR, MINN.-WIS.	142
			375	GREEN BAY, WIS.	192
			393	RENOSSA, WIS.	228

Table 6-2 (Continued).

STATE	B.E.A. SMSA CODE AND TITLE	PAGE
WISCONSIN	CONTINUED	
541	LA CROSSE, WIS.	234
415	MADISON, WIS.	278
422	MILWAUKEE, WIS.	294
480	RACINE, WIS.	374
WYOMING		
528	CHEYENNE, WYO.	104

Table 6-3. COUNTY COMPOSITION OF SMSAs LISTED IN BEA CODE NUMBER ORDER

300	ABILENE, TEX. JONES TAYLOR	TEX. TEX.	313	ATLANTIC CITY, N.J. ATLANTIC	N.J.
301	AKRON, OHIO PORTAGE SUMMIT	OHIO OHIO	314	AUGUSTA, GA.-S.C. AIKEN RICHMOND	S.C. GA.
302	ALBANY, GA. DOUGHERTY	GA.	315	AUSTIN, TEX. TRAVIS	TEX.
303	ALBANY-SCHENECTADY-TROY, N.Y. ALBANY RENSSELAER SARATOGA SCHENECTADY	N.Y. N.Y. N.Y. N.Y.	316	BAKERSFIELD, CAL. KERN	CAL.
304	ALBUQUERQUE, N.M. BERNALILLO	N.M.	317	BALTIMORE, MD. ANNE ARUNDEL BALTIMORE BALTIMORE (INDEPENDENT CITY) CARROLL HARFORD HOWARD	MD. MD. MD. MD. MD. MD.
305	ALLENTOWN-BETHLEHEM-EASTON, PA.-N.J. WARREN LEHIGH NORTHAMPTON	N.J. PA. PA.	318	BATON ROUGE, LA. EAST BATON ROUGE	LA.
306	ALTOONA, PA. BLAIR	PA.	319	BAY CITY, MICH. BAY	MICH.
307	AMARILLO, TEX. POTTER RANDALL	TEX. TEX.	320	BEAUMONT-PORT ARTHUR-ORANGE, TEX. JEFFERSON ORANGE	TEX. TEX.
308	ANAHEIM-SANTA ANA-GARDEN GROVE, CAL. ORANGE	CAL.	321	BILLINGS, MONT. YELLOWSTONE	MONT.
309	ANDERSON, IND. MADISON	IND.	322	BINGHAMTON, N.Y.-PA. BROOME TIOGA SUSQUEHANNA	N.Y. N.Y. PA.
310	ANN ARBOR, MICH. WASHTENAW	MICH.	323	BIRMINGHAM, ALA. JEFFERSON SHELBY WALKER	ALA. ALA. ALA.
311	ASHEVILLE, N.C. BUNCOMBE	N.C.	324	BLOOMINGTON-NORMAL, ILL. MCLEAN	ILL.
312	ATLANTA, GA. CLAYTON CORB GWINETT DEKALB • FULTON	GA. GA. GA. GA.			

Table 6-3 (Continued).

325	BOISE CITY, IDA. ADA	IDA.	BOONE CAMPBELL KENTON	KY. KY. KY.
329	BROWNSVILLE-HARLINGEN-SAN BENITO, TEX. CAMERON	TEX.	340 CLEVELAND, OHIO CUYAHOGA GEAUGA LAKE MEDINA	OHIO OHIO OHIO OHIO
330	BUFFALO, N.Y. EPIE NIAGARA	N.Y. N.Y.	341 COLORADO SPRINGS, COLO. EL PASO	COLO.
331	CANTON, OHIO STARK	OHIO	342 COLUMBIA, S.C. LEXINGTON RICHLAND	S.C. S.C.
332	CEDAR RAPIDS, IA. LINN	IOWA	343 COLUMBUS, GA.-ALA. CHATTAHOOCHEE MUSCOGEE RUSSELL	GA. GA. ALA.
333	CHAMPAIGN-UPBANA, ILL. CHAMPAIGN	ILL.	344 COLUMBUS, OHIO DELAWARE FRANKLIN PICKAWAY	OHIO OHIO OHIO
334	CHARLESTON, S.C. BERKELEY CHARLESTON	S.C. S.C.	345 CORPUS CHRISTI, TEX. NUECES SAN PATRICIO	TEX. TEX.
335	CHARLESTON, W.VA. FAYETTE KANAWHA	W.VA. W.VA.	346 DALLAS, TEX. COLLIN DALLAS DENTON ELLIS KAUFMAN ROCKWALL	TEX. TEX. TEX. TEX. TEX. TEX.
336	CHARLOTTE, N.C. MECKLENBURG UNION	N.C. N.C.	347 DAVENPORT-ROCK ISLAND-MOLINE, IA.-ILL. HENRY ROCK ISLAND SCOTT	ILL. ILL. IOWA
337	CHATTANOOGA, TENN.-GA. HAMILTON WALKER	TENN. GA.	348 DAYTON, OHIO GRENE MIAMI MONTGOMERY PREBLE	OHIO OHIO OHIO OHIO
338	CHICAGO, ILL. LAKE COOK DU PAGE KANE LAKE MCHEENRY WILL	IND. ILL. ILL. ILL. ILL. ILL. ILL.	349 DECATUR, ILL. MACON	ILL.
339	CINCINNATI, OHIO-KY.-IND. CLERMONT HAMILTON WARREN DEARBORN	OHIO OHIO OHIO IND.		

Table 6-3 (Continued).

350	DENVER, COLO.			364	FLINT, MICH.		
	ADAMS				GENESEE		
	ARAPAHOE	COLO.			LAPEER	MICH.	
	BOULDER	COLO.				MICH.	
	DENVER	COLO.					
	JEFFERSON	COLO.					
351	DES MOINES, IA.			365	FORT LAUDERDALE-HOLLYWOOD, FLA.		
	POLK	IOWA			BROWARD	FLA.	
352	DETROIT, MICH.			366	FORT SMITH, ARK.-OKLA.		
	MACOMB	MICH.			CRAWFORD	ARK.	
	OAKLAND	MICH.			SERASTIAN	ARK.	
	WAYNE	MICH.			LE FLORE	OKLA.	
					SEQUOYAH	OKLA.	
353	DUBUQUE, IA.			367	FORT WAYNE, IND.		
	DUBUQUE	IOWA			ALLEN	IND.	
354	DULUTH-SUPERIOR, MINN.-WISC.			368	FORT WORTH, TEX.		
	DOUGLAS	WISC.			JOHNSON	TEX.	
	ST. LOUIS	MINN.			TARRANT	TEX.	
355	DURHAM, N.C.			369	FRESNO, CAL.		
	DURHAM	N.C.			FRESNO	CAL.	
	ORANGE	N.C.					
356	EL PASO, TEX.			370	GADSDEN, ALA.		
	EL PASO	TEX.			ETOWAH	ALA.	
357	ERIE, PA.			371	GALVESTON-TEXAS CITY, TEX.		
	ERIE	PA.			GALVESTON	TEX.	
358	EUGENE-SPRINGFIELD, ORE.			372	GARY-HAMMOND-EAST CHICAGO, IND.		
	LANE	ORE.			LAKE	IND.	
					PORTER	IND.	
359	EVANSVILLE, IND.-KY.			373	GRAND RAPIDS, MICH.		
	VANDEBURGH	IND.			KENT	MICH.	
	WARRICK	IND.			OTTAWA	MICH.	
	HENDERSON	KY.					
361	FARGO-MOORHEAD, N.D.-MINN.			374	GREAT FALLS, MONT.		
	CLAY	MINN.			CASCADE	MONT.	
	CASS	N.D.					
362	FAYETTEVILLE, N.C.			375	GREEN BAY, WISC.		
	CUMBERLAND	N.C.			BROWN	WISC.	
				376	GREENSBORO-WINSTON-SALEM-HIGH POINT, N.C.		
					FORSYTH	N.C.	
					GUILFORD	N.C.	
					RANDOLPH	N.C.	
					YADKIN	N.C.	

Table 6-3 (Continued).

377	GREENVILLE, S.C.		388	JACKSONVILLE, FLA.	
	GREENVILLE	S.C.		DUVAL	FLA.
	PICKENS	S.C.			
378	HAMILTON-MIDDLETOWN, OHIO		389	JERSEY CITY, N.J.	
	BUTLER	OHIO		HUDSON	N.J.
379	HARRISBURG, PA.		390	JOHNSTOWN, PA.	
	CUMBERLAND	PA.		CAMBRIA	PA.
	DAUPHIN	PA.		SOMERSET	PA.
	PERRY	PA.			
381	HONOLULU, HAWAII		391	KALAMAZOO, MICH.	
	HONOLULU	HAWAII		KALAMAZOO	MICH.
382	HOUSTON, TEX.		392	KANSAS CITY, MO.-KAN.	
	BRAZORIA	TEX.		CASS	MO.
	FORT BEND	TEX.		CLAY	MO.
	HARRIS	TEX.		JACKSON	MO.
	LIBERTY	TEX.		PLATTE	MO.
	MONTGOMERY	TEX.		JOHNSON	KAN.
				WYANDOTTE	KAN.
383	HUNTINGTON-ASHLAND, W.VA.-KY.-OHIO		393	KENOSHA, WISC.	
	LAWRENCE	OHIO		KENOSHA	WISC.
	CABELL	W.VA.			
	WAYNE	W.VA.	394	KNOXVILLE, TENN.	
	BOYD	KY.		ANDERSON	TENN.
				BLOUNT	TENN.
384	HUNTSVILLE, ALA.			KNOX	TENN.
	LIMESTONE	ALA.	395	LAFAYETTE, LA.	
	MADISON	ALA.		LAFAYETTE	LA.
385	INDIANAPOLIS, IND.		396	LAKE CHARLES, LA.	
	BOONE	IND.		CALCASIEU	LA.
	HAMILTON	IND.			
	HANCOCK	IND.	397	LANCASTER, PA.	
	HENDRICKS	IND.		LANCASTER	PA.
	JOHNSON	IND.			
	MARION	IND.	398	LANSING-EAST LANSING, MICH.	
	MORGAN	IND.		CLINTON	MICH.
	SHELBY	IND.		EATON	MICH.
				INGHAM	MICH.
386	JACKSON, MICH.		399	LAREDO, TEX.	
	JACKSON	MICH.		WEBB	TEX.
387	JACKSON, MISS.				
	WINDS	MISS.			
	RANKIN	MISS.			

Table 6-3 (Continued).

400	LAS VEGAS, NEV.		418	MEMPHIS, TENN.-ARK.	
	CLARK	NEV.		SHELBY	TENN.
				CRITTENDEN	ARK.
402	LAWTON, OKLA.		420	MIAMI, FLA.	
	COMANCHE	OKLA.		DADE	FLA.
404	LEXINGTON, KY.		421	MIDLAND, TEX.	
	FAVET	KY.		MIDLAND	TEX.
405	LIMA, OHIO		422	MILWAUKEE, WISC.	
	ALLEN	OHIO		MILWAUKEE	WISC.
	PUTNAM	OHIO		OZAUKEE	WISC.
	VAN MERT	OHIO		WASHINGTON	WISC.
				WAUKESHA	WISC.
406	LINCOLN, NEB.		423	MINNEAPOLIS-S. PAUL, MINN.	
	LANCASTER	NEB.		ANOKA	MINN.
407	LITTLE ROCK-NORTH LITTLE ROCK, ARK.			DAKOTA	MINN.
	PULASKI	ARK.		HENNEPIN	MINN.
	SALINE	ARK.		RAMSEY	MINN.
				WASHINGTON	MINN.
408	LORAIN-ELYRIA, OHIO		424	MOBILE, ALA.	
	LORAIN	OHIO		BALDWIN	ALA.
				MOBILE	ALA.
409	LOS ANGELES-LONG BEACH, CAL.		425	MONROE, LA.	
	LOS ANGELES	CAL.		OUACHITA	LA.
	ORANGE	CAL.			
410	LOUISVILLE, KY.-IND.		426	MONTGOMERY, ALA.	
	CLARK	IND.		ELMORE	ALA.
	FLOYD	IND.		MONTGOMERY	ALA.
	JEFFERSON	KY.			
412	LUBBOCK, TEX.		427	MUNCIE, IND.	
	LUBBOCK	TEX.		DELAWARE	IND.
413	LYNCHBURG, VA.		428	MUSKEGON-MUSKEGON HEIGHTS, MICH.	
	AMHERST	VA.		MUSKEGON	MICH.
	CAMPBELL	VA.			
414	MACON, GA.		429	NASHVILLE, TENN.	
	BIBB	GA.		DAVIDSON	TENN.
	HOUSTON	GA.		SUMNER	TENN.
				WILSON	TENN.
415	MADISON, WISC.		434	NEW ORLEANS, LA.	
	DANE	WISC.		JEFFERSON	LA.
				ORLEANS	LA.
				ST. BERNARD	LA.
				ST. TAMMANY	LA.

Table 6-3 (Continued).

485	SHREVEPORT, LA. BOSSIER CADD0	LA. LA.	500	TAMPA-ST. PETERSBURG, FLA. MILLSBOROUGH PINELLAS	FLA. FLA.
486	SIOUX CITY, IA.-NEB. WOODBURY DAKOTA	IOWA NEB.	501	TERRE HAUTE, IND. CLAY SULLIVAN VERMILLION VIGO	IND. IND. IND. IND.
487	SIOUX FALLS, S.D. MINNEHAWA	S.D.	502	TEXARKANA, TEX.-ARK. MILLER BOWIE	ARK. TEX.
488	SOUTH BEND, IND. MARSHALL ST. JOSEPH	IND. IND.	503	TOLEDO, OHIO-MICH. MONROE LUCAS WOOD	MICH. OHIO OHIO
489	SPOKANE, WASH. SPOKANE	WASH.	504	TOPEKA, KAN. SHAWNEE	KAN.
490	SPRINGFIELD, ILL. SANGAMON	ILL.	505	TRENTON, N.J. MERCER	N.J.
491	SPRINGFIELD, MO. GREENE	MO.	506	TUCSON, ARIZ. PIMA	ARIZ.
492	SPRINGFIELD, OHIO CLARK	OHIO	507	TULSA, OKLA. CREEK OSAGE TULSA	OKLA. OKLA. OKLA.
495	STEBENVILLE-WEIRTON, OHIO-W.VA. JEFFERSON BROOKE MANCOCK	OHIO W.VA. W.VA.	508	TUSCALOOSA, ALA. TUSCALOOSA	ALA.
496	STOCKTON, CAL. SAN JOAQUIN	CAL.	509	TYLER, TEX. SMITH	TEX.
497	SYRACUSE, N.Y. MADISON ONONDAGA OSWEGO	N.Y. N.Y. N.Y.	510	UTICA-ROME, N.Y. HERKIMER ONEIDA	N.Y. N.Y.
498	TACOMA, WASH. PIERCE	WASH.	511	VALLEJO-FAIRFIELD-NAPA, CALIF. NAPA SOLANO	CAL. CAL.
499	TALLAHASSEE, FLA. LEON	FLA.			

Table 6-3 (Continued).

512	WACO, TEX. MC LENNAN	TEX.	525	YORK, PA. ADAMS YORK	PA. PA.
513	WASHINGTON, D.C.-MD.-VA. MONTGOMERY PRINCE GEORGES DISTRICT OF COLUMBIA ARLINGTON FAIRFAX LOUDOUN PRINCE WILLIAM	MD. MD. D.C. VA. VA. VA. VA.	526	YOUNGSTOWN-WARREN, OHIO MAHONING TRUMBULL	OHIO OHIO
515	WATERLOO, IA. BLACK HAWK	IOWA	527	BURLINGTON, VT. CHITTENDEN	VT.
516	WEST PALM BEACH, FLA. PALM BEACH	FLA.	528	CHEYENNE, WYO. LARAMIE	WYOM.
517	WHEELING, W.VA.-OHIO BELMONT JEFFERSON BROOKE HANCOCK MARSHALL OHIO	OHIO OHIO W.VA. W.VA. W.VA. W.VA.	529	LAFAYETTE-WEST LAFAYETTE, IND. TIPPECANOE	IND.
518	WICHITA, KAN. BUTLER SEDGWICK	KAN. KAN.	530	MANSFIELD, OHIO RICHLAND	OHIO
519	WICHITA FALLS, TEX. ARCHER WICHITA	TEX. TEX.	531	ANCHORAGE, ALASKA THIRD JUDICIAL DISTRICT	ALASKA
520	WILKES-BARRE-HAZLETON, PA. LUZERNE	PA.	532	MCALLEN-PHARR-EDINBURG, TEX. HIDALGO	TEX.
521	WILMINGTON, DEL.-N.J.-MD. SALEM NEW CASTLE CECIL	N.J. DEL. MD.	533	SALINAS-SEASIDE-MONTEREY, CALIF. MONTEREY	CAL.
522	WILMINGTON, N.C. BRUNSWICK NEW MANOVER	N.C. N.C.	534	SHERMAN-DENISON, TEX. GRAYSON	TEX.
523	WINSTON-SALEM, N.C. FORSYTH	N.C.	535	BILOXI-GULFPORT, MISS. HARRISON	MISS.
			536	VINELAND-MILLVILLE-BRIDGETON, N.J. CUMBERLAND	N.J.
			537	APPLETON-OSHKOSH, WISCONSIN CALUMET OUTAGAMIE WINNEBAGO	WISC. WISC. WISC.

Table 6-3 (Continued).

538	BRYAN-COLLEGE STATION, TEXAS BRAZOS	TEX.	556	FORT MYERS, FLA. LEE	FLA.
539	COLUMBIA, MISSOURI BOONE	MO.	557	GASTONIA, N. C. GASTON	N.C.
540	GAINESVILLE, FLORIDA ALACHUA	FLA.	558	KILLEEN-TEMPLE, TEXAS BELL CORYELL	TEX. TEX.
541	LA CROSSE, WISCONSIN LA CROSSE	WISC.	559	LAKELAND-WINTER HAVEN, FLA. POLK	FLA.
542	MODESTO, CALIFORNIA STANISLAUS	CALIF.	560	LONG BRANCH-ASBURY PARK, N. J. MONMOUTH	N.J.
543	OWENSBORO, KENTUCKY DAVIES	KY.	561	NEW BRUNSWICK-PERTH AMBOY-SAYREVILLE, N.J. MIDDLESEX	N.J.
544	PETERSBURG-COLONIAL HEIGHTS-HOPEWELL, VA. DINWIDDIE + PETERSBURG PRINCE GEORGE + HOPEWELL	VA. VA.	562	PARKERSBURG-MARIETTA, W.VA.-OHIO WASHINGTON WOOD	OHIO W.VA.
545	ROCHESTER, MINNESOTA OLMSTEAD	MINN.	563	POUGHKEEPSIE, N. Y. DUTCHESS	N.Y.
546	SANTA ROSA, CALIFORNIA SONOMA	CALIF.	564	RICHLAND-KENNEWICK, WASH. BENTON FRANKLIN	WASH. WASH.
551	ALEXANDRIA, LA. RAPIDES	LA.	565	SANTA CRUZ, CAL. SANTA CRUZ	CAL.
552	BATTLE CREEK, MICH. CALHOUN	MICH.	567	SARASOTA, FLA. SARASOTA	FLA.
553	DAYTONA BEACH, FLA. VOLUSIA	FLA.	568	SPARTANBURG, S. C. SPARTANBURG	S.C.
554	ELMIRA, N. Y. CHEMUNG	N.Y.	569	WILLIAMSPORT, PA. LYCOMING	PA.
555	FLORENCE, ALA. COLBERT LAUDERDALE	ALA. ALA.	570	YAKIMA, WASH. YAKIMA	WASH.

Table 6-3 (Continued).

571	MELBOURNE-TITUSVILLE-COCOA, FLA.	942	PROVIDENCE-WARWICK-PANTUCKET, R.I.
	BREVARD FLA.		BRISTOL R.I.
			KENT R.I.
930	BRIDGEPORT-NORWALK-STAMFORD-DANBURY, CONN.		PROVIDENCE R.I.
	FAIRFIELD CONN.		
931	NEW HAVEN-WATERBURY-MERIDEN, CONN.		
	NEW HAVEN CONN.		
932	HARTFORD-NEW BRITAIN-BRISTOL, CONN.		
	HARTFORD CONN.		
933	NORWICH-GROTON-NEW LONDON, CONN.		
	NEW LONDON CONN.		
934	BOSTON, MASS.		
	ESSEX MASS.		
	MIDDLESEX MASS.		
	NORFOLK MASS.		
	PLYMOUTH MASS.		
	SUFFOLK MASS.		
935	FALL RIVER-NEW BEDFORD, MASS.		
	BRISTOL MASS.		
936	PITTSFIELD, MASS.		
	BERKSHIRE MASS.		
937	SPRINGFIELD-CHICOPEE-MOLYOKE, MASS.		
	HAMPDEN MASS.		
	HAMPSHIRE MASS.		
938	WORCESTER-FITCHBURG-LEOMINSTER, MASS.		
	WORCESTER MASS.		
939	PORTLAND-SOUTH PORTLAND, ME.		
	CUMBERLAND ME.		
940	LEWISTON-AUBURN, ME.		
	ANDROSCOGGIN ME.		
941	MANCHESTER-NASHUA, N.H.		
	HILLSBOROUGH N.H.		

APPENDIX A - BASIS FOR INITIAL DESIGNATION CRITERIA

This Appendix provides the technical derivation of the initial designation criteria presented in Section 3 of this report.

A.1 CARBON MONOXIDE

The variable exclusion criteria for carbon monoxide presented in Section 3 are derived by using the model for CO presented in Section 5 of these guidelines. The criteria are in the form of a curve which specifies, for a given local vehicle mix of light- versus heavy-duty vehicle emissions, a critical CO concentration below which an SMSA can be excluded from consideration as an AQMA, and above which the SMSA must be subjected to further analysis using the techniques presented in Section 4 and 5 of this document. The derivation of the criteria curve follows:

The CO model presented in Section 5 of this document is represented by the three following equations:

$$F_T = F_L + F_U + b \quad (A-1)$$

$$\frac{F_L}{0.8 (B-b)} = \frac{P_L G_L^* E_L + P_H G_H^* E_H}{P_L + P_H} \quad (A-2)$$

$$\frac{F_U}{0.2 (B-b)} = \frac{P_L G_L E_L + P_H G_H E_H + P_S G_S E_S}{100\%} \quad (A-3)$$

where: F_T = Total future (1985) CO concentration

F_L = Future concentration due to local traffic

F_U = Future concentration due to urban emission

b = Background concentration

B = Baseline concentration (measured or estimated)

P_L = Percent emission from light-duty vehicles (gross vehicle weight < 6000 lb)

P_H = Percent emission from other mobile sources (gross vehicle weight > 6000 lb)

P_S = Percent emission from stationary sources

G = Growth factor over the projection period, $G^* \neq G$

E = Expected ratio of 1985 emission to baseline emission for a composite source.

G^* = Growth factor for traffic on the local street of interest

The "future" air quality (F_T) will be set equal to the CO standard, and the light- versus heavy-duty vehicle mix will be varied for the local street condition to yield corresponding critical baseline concentrations.

The following assumptions will be made in applying the model:

- (a) Background concentration (b) = 1 ppm.
- (b) The CO standard to be considered is the 8-hour standard of 9 ppm ($= F_T$).
- (c) The growth of mobile and stationary sources will be assumed to be 5 percent annually (r) for urban areas. For a 1970 baseline, the projection period to 1985 is 15 years (n).

Thus, the growth factor is given by

$$G = (1 + r)^n = (1 + 0.05)^{15} = 2.08$$

Therefore, a 1970-1985 growth factor of 2.0 will be used for all urban sources, so

$$G_L = G_H = G_S = 2.0$$

- (d) Growth of local traffic ($G_L^* = G_H^*$) will be less than total urban growth due to "saturation" of local streets with current traffic; assume $G_L^* = G_H^* = 1.2$.

- (e) The emission factor ratios from Table 5-1 will be used; no control over stationary sources of CO will be assumed; thus

$$E_L = 0.08$$

$$E_H = 0.93$$

$$E_S = 1.0$$

- (f) The percent contribution of CO emissions from stationary sources is assumed to be 20. The percent contribution of CO emissions from light- and heavy-duty vehicles for the local street case will be treated differently than for the urban case. For the local street case (F_L), the P_L and P_H values will vary; for the urban case (F_U), assume $P_L = 70$ and $P_H = 10$. In either case, since $P_S = 20$, $P_L + P_H = 80$.

For the local case, Equation (A-2) is used; inserting the values assumed above yields

$$\frac{F_L}{0.8 (B-1)} = \frac{P_L (1.2)(0.08) + P_H (1.2)(0.93)}{80}$$

$$F_L = (B-1) \left[\frac{P_L (0.077) + P_H (0.89)}{80} \right]$$

For the urban case, Equation (A-3) is used, yielding

$$\frac{F_U}{0.2 (B-1)} = \frac{(70)(2.0)(0.08) + (10)(2.0)(0.93) + (20)(2.0)(1.0)}{100}$$

$$F_U = (B-1)(0.140)$$

From Equation A-1,

$$F_T = F_L + F_U + b$$

Inserting the above values yields

$$9 = (B-1) \left[\frac{P_L (0.077) + P_H (0.89)}{80} \right] + (B-1)(0.140) + 1$$

or

$$B = \left(\frac{\frac{P_L (0.077) + P_H (0.89)}{80} + 0.140}{1} \right) + 1$$

Substituting varying values of P_L and P_H yields the corresponding values of B given in Table A-1. From these values, the criteria curve given as Figure 3 is derived.

There is no initial inclusion threshold for CO . As a result, any area which is not automatically excluded must be subjected to further analysis as indicated in Sections 4 and 5.

A.2 TOTAL SUSPENDED PARTICULATES

Nationwide emissions of TSP are not expected to increase. The combination of SIP requirements for existing source emission reduction, attrition of existing sources, and the requirement that new sources meet NSPS should result in a continuing decrease in TSP emissions through 1985. Therefore, areas in which all NAAQS for TSP are presently being met need not be designated as AQMAs for TSP.

There is no inclusion threshold for TSP other than the projected violation of a NAAQS in 1985. Those areas in which a "reasonable time" for attainment of a secondary NAAQS for TSP extends beyond 1985 must be declared AQMAs for TSP. For other areas currently exceeding NAAQS for TSP, the analytical techniques presented in Section 5 may be used to project TSP concentration to 1985.

A.3 SULFUR OXIDES

Nationally, most SIP requirements for control of SO_2 in urban areas have been implemented. Control methods for SO_x emissions are not as advanced as controls for TSP. Consequently, growth of SO_x sources may result in a net

Table A-1. SOLUTIONS TO EQUATION

$$B = \left[\frac{P_L (0.077) + \frac{8}{P_H} (0.89)}{80} + 0.140 \right] + 1$$

Percent Contribution of LDV Emissions to Total Local Street Vehicle Emissions	P _L	P _H	B
0	0	80	8.8
10	8	72	9.4
20	16	64	10.2
30	24	56	11.2
40	32	48	12.3
50	40	40	13.8
60	48	32	15.7
70	56	24	18.3
80	64	16	22.1
90	72	8	27.8
100	80	0	37.9

increase of SO_x emissions even though NSPS for SO_x are applied to new sources. Therefore, an indicator of growth is contained in the exclusion criteria for SO_x .

If the product of the highest measured SO_2 concentration of each averaging time and a growth factor based on projected SMSA total earnings is less than any NAAQS for SO_2 , the area may be excluded as an AQMA for SO_2 . Total earnings in the SMSA was selected as the best indicator of emission growth potential that is readily available. The growth factor is computed from

$$G = \left(1 + \frac{r}{100}\right)^n = \frac{V_{85}}{V_b}$$

Where

G = Relative growth factor

r = Growth rate, %/year

n = number of years between the base year and 1985

V_{85} = Value in dollars of total earnings in 1985

V_b = Value in dollars of total earnings in base year

The inclusion criteria for SO_2 are identical to those for TSP.

A.4 PHOTOCHEMICAL OXIDANTS

All areas for which transportation controls are required for oxidants must be designated AQMA's for oxidants. Although Mobile Source Performance Standards (MSPS) and NSPS for hydrocarbons will lower oxidant concentrations below NAAQS by 1985 in some areas, other areas, particularly those with high stationary source HC emissions, may have difficulty meeting NAAQS without further HC emission control. It is therefore considered prudent to subject areas requiring special HC emission control (i.e., transportation control

areas) to the air quality maintenance analysis required following AQMA designation.

An area may be excluded from AQMA designation if (1) it is not a transportation control area for oxidants, and (2) measured peak hourly oxidant concentration is less than twice the NAAQS for oxidants (0.16 ppm or $320 \mu\text{g}/\text{m}^3$). This latter exclusion threshold is arrived at through the following reasoning.

The combination of MSPS, NSPS, and growth is expected to result in about a 55 per cent reduction in HC emission from the average metropolitan area by 1985. Both Appendix J and proportional models indicate that a 55 per cent HC emission reduction should produce a 55 per cent oxidant concentration reduction. Furthermore, the reduction in the HC/NO_x ratio, which is the likely consequence of present and expected emission control regulations, should reduce oxidant concentrations even more than predicted by Appendix J or proportional modeling. It follows that an area presently exhibiting less than double the NAAQS for oxidant should achieve NAAQS by 1985 provided MSPS and NSPS are effectively applied and enforced.

Areas which exhibit oxidant concentrations above $320 \mu\text{g}/\text{m}^3$ but are not subject to transportation controls may estimate 1985 oxidant concentration using the methods presented in Section 5.

A.5 NITROGEN DIOXIDE

Future NO_2 concentrations were projected by EPA for all regions likely to exceed NO_2 NAAQS. These projections were made in connection with the re-examination of the MSPS for NO_x . The results of this analysis indicate that NAAQS for NO_2 are threatened only in the Los Angeles, Chicago, New York, Denver, and Wasatch Front AQCRs. Consequently, only the urbanized portions of

these AQCRs need be designated AQMAs for NO₂. All other areas may be omitted.

APPENDIX B - EXAMPLES OF ANALYSES FOR A HYPOTHETICAL SMSA EMPLOYING THE "BACK-UP" METHOD OF ESTIMATING EMISSIONS

This appendix presents example calculations for carbon monoxide, sulfur dioxide, and hydrocarbons/photochemical oxidants. The hypothetical SMSA is assumed to be located in a state which will be under a significant burden and must resort to the "back-up" method of calculating emissions allowed after application of all SIP control strategies. As stated in Section 4 of this guideline, however, the "preferred" method is to be employed in most cases, rather than the "back-up" method. The "preferred" method is the method used by the states in developing the control strategies for "example regions", i.e., application of SIP regulations to all emissions, source by source, to determine allowable emissions in 1975 (or 1977, if an extension for attaining the NAAQS was granted). The "back-up" method is presented here merely to demonstrate its use, but its use should be restricted to those states which will be faced with a heavy burden in designating the air quality maintenance areas. Before deciding to use the "back-up" method, states should discuss the problems of using the "preferred" method with the representative responsible for maintenance of standards in the appropriate EPA Regional Office.

B.1. EXAMPLE 1 - CARBON MONOXIDE

1. Assume that the hypothetical SMSA has a current carbon monoxide air quality of 30 ppm, second highest 8-hour average per year. Also assume that the percent of local mobile source emissions contributed by light-duty vehicles (LDV) is 80. This percentage is below the critical exclusion concentration of 94 per cent shown on Figure 3-1. As a result of

the 80 per cent assumption, the per cent of local mobile source emissions contributed by heavy duty vehicles (HDV) would be 20 if the further assumption is made that no stationary sources contribute carbon monoxide in the local area around the samplers. Upon application of the initial designation criteria found in Section 3 of the guideline, this air quality does not qualify the area for automatic exclusion or inclusion as an SMSA, since the exclusion cutoff value is 21 ppm for an 80 per cent local mobile source emissions contribution by light-duty vehicles. Therefore, emissions and air quality will have to be projected for the area. Assume that the hypothetical area had the 1970 emissions of CO in tons per year as shown in Table B-1.

The data from Table B-1 are then entered in Columns A and B of Table B-2 as shown.

2. Assume that the following annual growth rates were projected for the hypothetical area (the 5-year (1970-1975) and 10-year (1975-1985) compounded growth rates are also given).

<u>Category</u>	<u>Annual</u>	<u>5-year</u>	<u>10-year</u>
Population	2.1%	11%	23%
Total earnings	4.5%	25%	55%
Manufacturing earnings	4.1%	22%	50%

3. Assume for the hypothetical area that new power plants would contribute an additional 300 tons of CO per year in 1975.
4. Place the proper emission reduction factors from Table 4-2 in Column C.
5. The growth factor for 1970-1975 is inserted in Column C-1. This factor is obtained from the 5-year demographic-economic parameters, and is expressed as the ratio of the 1975 value to the 1970 value (i.e., 25 per cent is expressed as 1.25).

Table B-1. 1970 EMISSIONS OF CO FOR HYPOTHETICAL SMSA

<u>SOURCE</u>	<u>CO EMISSIONS (Tons/year)</u>
Fuel combustion	
Power plants	1,200
Point sources excluding power plants	400
Area sources	<u>400</u>
Subtotal	2,000
Industrial point sources	7,000
Solid waste disposal	
Point sources	100
Area sources	<u>1,900</u>
Subtotal	2,000
Transportation	
LDV	755,000
HDV	<u>95,000</u>
Subtotal	850,000
Miscellaneous	
Point sources	500
Area sources	<u>500</u>
Subtotal	<u>1,000</u>
Total	862,000

Table B-2. EMISSION PROJECTION CALCULATION TABLE FOR CARBON MONOXIDE

A	B	C	C-1	D	E	F	G
Source class	1970 emissions	Reduction factors (Table 4-2)	Growth factor (1975/1970)	1975 emissions	Growth rate (1985/1975-1)	Emission factor adjustment	1985 emissions $G = D(1 + EF)$
Fuel combustion							
Power plants	1,200	1.0	---	1500 (=1200+300)			
Point sources (excl pp)	400	1.0	1.25	500			
Area sources	400	1.0	1.25	500			
Subtotal	2,000			2,500	0.55	1.00	3,900 ^R
Industrial point sources	7,000	0.10	1.22	900 ^R	0.50	0.40	1,100 ^R
Solid waste disposal							
Point sources	100	0.52	1.11	57			
Area sources	1,900	0.88	1.11	1,840			
Subtotal	2,000			1,900 ^R	0.23	1.00	2,300 ^R
Transportation							
LDV	755,000						83,000 ^R
HDV	95,000						121,000 ^R
Subtotal	850,000						204,000 ^R
Miscellaneous							
Point sources	500						
Area sources	500						
Subtotal	1,000	1.00	1.25	1,250	0.55	1.00	1,900 ^R
Totals	862,000						212,000 ^R

R-indicates rounding.

6. Column D is calculated for all categories except power plants and transportation by taking the product of Columns B, C, and C-1. The 1975 power plant emissions are given by the product of Columns B and C, to which is added the emissions from new power plants.
7. The appropriate 10-year growth rates are entered in Column E for all categories except transportation; these rates are expressed as the ratio of the 1985 value to the 1975 value, minus unity (one).
8. The appropriate emission factor adjustments are entered in Column F.
9. Column G is computed for all categories except transportation by the given equation.
10. Transportation emissions are then calculated by Equation 4-1 from Part 4:

$$Q_{1985} = \sum (Q_{\text{base}}) G_i E_i$$

The growth rate for transportation emissions should be determined from available data if such exist. If no such data exist, use the growth rate for population. For the hypothetical area, this is 2.1 per cent. Therefore, $G = (1 + 0.021)^{15} = 1.37$. E values are found in Table 5-1. For carbon monoxide, $E_{\text{LDV}} = 0.08$; and $E_{\text{HDV}} = 0.93$.

$$\begin{aligned} \therefore Q_{85} &= (755,000)(1.37)(0.08) + (95,000)(1.37)(0.93) \\ &= 83,000 + 121,000 = 204,000 \text{ tons per year} \end{aligned}$$

11. Total Column G for a grand total of 212,000 tons per year for 1985 emissions for carbon monoxide.
12. Carbon monoxide concentrations are calculated by the method given in section 5.2. Assume a growth factor G^* for local street traffic of 1.0 if an actual value is not known.

$$F_T = F_L + F_U + b$$

$$F_L = 0.8(B-b) \left[\frac{P_L G_L^* E_L + P_H G_H^* E_H}{P_L + P_H} \right]$$

For the local area assume:

$$B = 30 \text{ ppm}$$

$$b = 1 \text{ ppm}$$

$$P_L = 80.0 \quad P_H = 20.0$$

$$G_L^* = 1.0 \quad G_H^* = 1.0$$

$$E_L = 0.08 \quad E_H = 0.93$$

$$\begin{aligned} \therefore F_L &= 0.8 (30-1) \left[\frac{80(1.0)(0.8) + 20(1.0)(0.93)}{80 + 20} \right] \\ &= 0.8(29) \left[\frac{6.4 + 18.6}{100} \right] \\ &= 5.8 \text{ ppm} \end{aligned}$$

For the entire urban area:

$$F_U = 0.2(B-b) \left[\frac{P_L G_L^* E_L + P_H G_H^* E_H + P_S G_S^* E_S}{100\%} \right]$$

Assume:

$$P_L = 87.6 \quad P_H = 11.0 \quad (\text{Refers to 1970 percentages calculated from Table B-2.})$$

Since stationary source emissions for 1985 have already been computed,

$P_S G_S^* E_S$ = the ratio of 1985 stationary source emissions to total 1975 emissions or = $8,000/862,000 = 1\%$

$$G_L = G_H = 1.37 \quad (=1970 \text{ to } 1985 \text{ growth in population})$$

$$\begin{aligned} \therefore F_U &= 0.2 (30-1) \left[\frac{(87.6)(1.37)(.08) + (11.0)(1.37)(0.93) + 1}{100} \right] \\ &= 0.2(29) \left[\frac{9.6 + 14.2 + 1}{100} \right] \end{aligned}$$

$$F_U = 1.4$$

$$\therefore F_T = F_L + F_U + b$$

$$= 5.8 + 1.4 + 1$$

= 8.2 ppm, second highest 8-hour average

B.1.1 Conclusion

Since this concentration is below the standard of 9 ppm, second highest 3-hour average, this SMSA would not be designated as an AQMA for CO.

B.2 EXAMPLE 2 - SULFUR DIOXIDE

1. Assume that the hypothetical area has a most recent annual arithmetic mean SO_2 concentration of $150 \mu\text{g}/\text{m}^3$, but has been projected to attain the SO_2 secondary standard before 1985. Since the current air quality concentration for SO_2 is above even the primary standard, the area cannot be automatically eliminated as an obvious non-problem area. Likewise, since the attainment of the secondary NAAQS has been projected before 1985 due to the current control strategy, the area cannot be automatically included as an obvious problem area. Consequently, the area must be subjected to further analysis consisting of a projection of emissions and air quality.

Note that if the current air quality concentration were below the secondary NAAQS for SO_2 , one would compute the product of the current concentration and the relative growth in total earnings between the base year and 1985 (the relative growth = $1 +$ the percentage growth rate over the period of interest). If this product is still below the secondary NAAQS for SO_2 , the area could be automatically excluded as an AQMA; if this product were above the secondary NAAQS for SO_2 , analysis would be required for the area to determine if it should be selected as an AQMA.

Assume that the hypothetical area had 1970 emissions of SO_2 as shown in Table B-3.

Table B-3. 1970 EMISSIONS OF SULFUR DIOXIDE FOR HYPOTHETICAL SMSA

<u>Source</u>	<u>Emissions (tons/year)</u>
Fuel combustion	
Power plants	250,000
Point sources excluding power plants	100,000
Area sources	<u>100,000</u>
Subtotal	450,000
Industrial point sources	60,000
Solid waste disposal	
Point sources	
Area sources	
Subtotal	ileg
Transportation	
LDV	
Other mobile	
Subtotal	2,000
Miscellaneous	
Point sources	
Area sources	
Subtotal	<u>0</u>
Total	512,000

The data from Table B-3 are entered into Columns A and B of Table B-4 as shown.

2. The same growth rates apply as in Example 1 above.
3. Assume for the hypothetical area that new power plants would contribute an additional 20,000 tons per year in 1975. Of course, in actuality, it is recommended that this figure be obtained from consultation with electric utility companies.
4. Place the proper emission reduction factors from Table 4-2 in Column C.
5. The growth for 1970-1975 obtained from the 5-year demographic-economic parameters is inserted in Column C-1, expressed as the ratio of the 1975 value to the 1970 value (i.e., 25 per cent is expressed as 1.25). For particulate matter and SO_2 from transportation sources, assume the same growth as that of population.
6. Column D is calculated for all categories except power plants and transportation by taking the product of Columns B, C, and C-1. The 1975 power plant emissions are given by the product of Columns B and C, to which is added the emission from new power plants.
7. The appropriate 10-year growth factors are entered in Column E of all categories. For particulate matter and SO_2 from transportation, assume the same growth as population. The growth factors here are expressed as the ratio of the 1985 value to the 1975 value, minus unity (one).
8. The appropriate emission factor adjustments are entered in Column F.
9. Column G is computed for all categories by the given equation.
10. Column G is totalled, yielding 1985 SO_2 emissions of 406,000 tons per year.

Table B-4. EMISSION PROJECTION CALCULATION TABLE FOR SULFUR DIOXIDE

A Source class	B 1970 emissions	C Reduction factors (Table 4-2)	C-1 Growth factor (1975/1970)	D 1975 emissions ^a (1985/1975 -1)	E Growth rate (1985/1975 -1)	F Emission factor adjustment	G 1985 emission G = D(1 +EF)
Fuel combustion							
Power plants	250,000	0.43	---	130,000 (=110,000 + 20,000)			
Point sources ^b	100,000	0.43	1.25	54,000 ^R			
Area sources	100,000	0.57	1.25	54,000	0.55	1.0	370,000
Subtotal	450,000			238,000			
Industrial point sources	60,000	0.37	1.22	27,000 ^R	0.51	0.4	34,000
Solid waste disposal							
Point sources							
Area sources				0	---	---	
Subtotal	Neg	---	---				
Transportation							
LDV							
HDV							
Subtotal	2,000	1.00	1.10	2,200	0.23	1.0	2,000
Miscellaneous							
Point sources							
Area sources				0	---		
Subtotal	0	---	---				
Totals	512,000						406,000

^aR - indicates rounding.^bExcluding power plants.

11. SO_2 concentrations can now be calculated. Assume that the area has an annual arithmetic mean SO_2 concentration of $150 \mu\text{g}/\text{m}^3$. For this example, the incremental version of the Miller-Holzworth Model (Section 5.4.2) will be used to project air quality. Assume that this hypothetical SMSA has an area of 1000 square kilometers. The urbanized area is hypothesized to be 400 square kilometers (160 mi^2) and it is assumed that 85 per cent of the emissions are emitted within the urbanized area.

Therefore, the 1970 and 1985 emissions from the urbanized area, together with the emission densities are:

	<u>1970</u>	<u>1985</u>
SMSA (tons/year)	512,000	406,000
Urban area (tons/year)	435,000	345,000
Urban area emission density (tons/year- mi^2)	2,720	2,160

The incremental Miller-Holzworth Model is given by:

$$\Delta x = 0.011 \Delta Q \left[3.61 H^{0.13} + \frac{800S}{uH} - \frac{(5.5 \times 10^{-5}) u H^{1.26}}{S} \right] \quad (\text{B-1})$$

or

$$\Delta x = 0.011 \Delta Q (1600 S/u)^{0.115} \quad (\text{B-2})$$

For the hypothetical SMSA, assume the following conditions:

- a mean annual morning mixing height of $500 \text{ m} = H$
- a mean annual morning wind speed of $5 \text{ m/sec} = u$
- a city size = $\sqrt{400 \text{ km}^2} = 20 \text{ km} = 12.4 \text{ mi} = S$

If $1600 S/u < 0.471 H^{1.13}$, Equation B-2 is used.

$$1600 \frac{12.4}{5} = 3970$$

$$0.471 H^{1.13} = 0.471 (500)^{1.13} = 0.471 (1100) = 518$$

Since $1600 S/u > 0.471 H^{1.13}$, Equation B-1 is used.

$$\Delta Q = (Q_{1985} - Q_{1970}) = 2,160 - 2,720 = -580 \text{ tons/yr-mi}^2$$

Inserting this ΔQ value in Equation B-1 yields:

$$\begin{aligned} \Delta X &= 0.001 (-580) \left[3.61 (500)^{0.13} + \frac{800 (12.4)}{(5)(500)} - \frac{(5.5 \times 10^{-5})(5)(500)^{1.26}}{(12.4)} \right] \\ &= -6.38 [8.09 + 3.97 - 1.11 \times 10^{-2}] \\ &= -6.38 (12.1) \\ &= -77 \mu\text{g/m}^3 \end{aligned}$$

$$\therefore X_{1985} = X_{1970} + \Delta X$$

$$= 150 - 77$$

$$= 73 \mu\text{g/m}^3 \text{ annual arithmetic mean}$$

12. To calculate the short-term concentrations, the log-normal model described in Section 5.4.3.2 of the guideline is used. Assume that the most recent standard geometric deviation of the hypothetical area is 2.05 for averaging times of 3 hours, and the ratio of the annual maximum 3-hour concentration to the mean concentration is 9.74. These values are underlined for reference in Table 5-2. Therefore, the projected 3-hour maximum concentration is:

$$(73 \mu\text{g/m}^3)(9.74) = 710 \mu\text{g/m}^3$$

B.2.1 Conclusion

Since $710 \mu\text{g/m}^3$ (3-hour maximum concentration) is less than the standard of $1300 \mu\text{g/m}^3$ (second highest 3-hour value per year) the area would not be designated as an AQMA for SO_2 .

B.3 EXAMPLE 3 - HYDROCARBONS AND PHOTOCHEMICAL OXIDANTS

1. Assume that the area has a current photochemical oxidant concentration of $350 \mu\text{g}/\text{m}^3$, second highest 1-hour concentration per year, but the area is not required to have a transportation control strategy. Therefore, it cannot be automatically included or excluded based on the criteria presented in Section 3 of the guideline. The area must, therefore, be subjected to further analysis consisting of an estimate of emissions and air quality.

NOTE: The projection of emissions is not presented here, since it is done in a fashion much the same as for carbon monoxide. Instead, it is assumed that total 1970 hydrocarbon emissions were 170,000 tons per year and that 1985 hydrocarbon emissions are projected to be 100,000 tons per year.

2. Section 5 of the guideline presents the method for estimating photochemical oxidant concentrations. The expected emission reduction is given by

$$R_{\text{expected}} = \frac{E_{\text{base}} - E_{1985}}{E_{\text{base}}} \times 100\%$$

$$\begin{aligned} R_{\text{expected}} &= \frac{170,000 - 100,000}{170,000} \times 100\% \\ &= \frac{70,000}{170,000} \times 100\% \\ &= 41.2\% \end{aligned}$$

3. The required emission reduction is obtained from the plot in Appendix J of 40 CFR Part 51 (published in the August 14, 1971 Federal Register). For a current photochemical oxidant concentration of $350 \mu\text{g}/\text{m}^3$ (0.18 ppm), second highest 1-hour concentration per year, Appendix J indicates that a reduction of 60 percent is required.

B.3.1 Conclusion - Since the required reduction of 60 percent is greater than the expected reduction of 41.2, the area would be designated as an AQMA for photochemical oxidants.

APPENDIX C - LIST OF TASKS TO BE PERFORMED FOR MAINTENANCE OF STANDARDS
PROGRAM

This preliminary list of tasks is being provided for use by the states to outline the work they must do in maintaining standards. The list can be used to plan and schedule activities and to estimate manpower requirements. A more detailed description of the work to be done will be provided in the guidelines which will follow. This list of tasks, however, should not be construed as a final outline of the plan.

The tasks involved can be partitioned into three major groups:

- I. Submit areas designated as AQMAs.
- II. Analyze emissions and air quality--1975 to 1985.
- III. Develop and submit a 10-year plan for air quality maintenance.

C.1 SUBMIT AREAS DESIGNATED AS AQMAs

The objective of this group of tasks is to determine which SMSAs and other areas meet the criteria for designation of AQMAs. The tasks are:

1. Assemble information on emission inventory, air quality, emission regulations, status of compliance, and future power plant construction and fuel-use patterns.
2. Apply initial designation criteria, using procedures outlined in the guidelines, to arrive at designated AQMAs.
3. Conduct public hearings in designated AQMAs.
4. Submit designated AQMAs to EPA with back-up documentation.

C.2 ANALYZE EMISSIONS AND AIR QUALITY -- 1975 to 1985

The objective of this group of tasks is to determine which areas are really problem areas with regard to maintaining standards and, thus, which

areas require maintenance plans. This determination will be done by conducting an in-depth analysis of all the major factors that will affect air quality in the period 1975 to 1985 using guidelines and models to be issued by EPA.

The tasks to be performed here have a different purpose than those performed in Group I above. In the case of Group I tasks, it was only necessary to identify AQMA's on the basis of specific designation criteria. However, Group II tasks must go beyond that and quantitatively evaluate the air pollution problem in each AQMA for the period 1975 to 1985. The tasks are:

1. Determine baseline emissions for each pollutant for which the AQMA was designated:
 - a. By source category.
 - b. By location as required by EPA models.
2. Identify principal sources (baseline and projected to 1985).
3. Acquire all necessary data to determine growth in emissions from 1975 to 1985 by source category and location for each pollutant. This would involve acquiring data on:
 - a. Past trends.
 - b. Planned and projected economic and demographic growth.
 - c. Projected control technology.
 - d. Present and future regulations for new and existing sources.
 - e. Meteorological data.
4. Project a detailed emission inventory for 1975 to 1985 by source category for each pollutant.
5. Project 1975 to 1985 air quality using calibrated diffusion models to be provided by EPA. Use these models to:

- a. Analyze the impact of indirect sources.
 - b. Analyze the impact of new sources.
6. Determine which AQMA's are problem areas and require 10-year maintenance plans. (A problem area is any portion of an AQMA in which the above analysis indicates any standard may be violated at any time between the date of attainment of the standard and 1985.)

C.3 DEVELOP AND SUBMIT A 10-YEAR PLAN FOR AIR QUALITY MAINTENANCE

The objective of this group of tasks is to have the states develop and submit a plan for maintenance of air quality in 1975 to 1985 in each AQMA determined to be a problem area. The tasks to be performed by the states can be inferred from the following outline of the content of the plan:

1. Plan overview -- Each state must prepare a plan overview document summarizing the content of the plan; it should include the following:
 - a. A description of what the plan is about and why it is required, so that lay citizens will have sufficient background knowledge to participate in public hearings on the plan.
 - b. A list of documents that constitute the plan, with each document or portion thereof identified according to the pollutant and AQMA it deals with.
 - c. A list of any documents or portions of the SIP, as it will exist immediately prior to the submission of the 10-year plan, that are being revised, rescinded, or supplemented by the 10-year plan, and a brief description of the salient features of such changes.

2. Required demonstrations

Each state must:

- a. Certify that public hearings have been held pursuant to 40 CFR 51.4(d).

- b. Demonstrate the presence of legal authority to adopt and implement the 10-year plan, pursuant to 40 CFR 51.11.
- c. Provide documentation that the intergovernmental cooperation required by 40 CFR 51.21(a) and 51.21(c) has been established. Identify the local agencies pursuant to 40 CFR 51.21(b)(1) and describe the distribution of responsibilities among state and local agencies in preparing, submitting and implementing the 10-year plan.
- d. Describe how the 10-year plan will provide for coordination of air quality maintenance activities with other local environmental protection activities including, but not limited to, the following activities:
 - i. Water planning.
 - ii. Solid waste disposal planning.
 - iii. Comprehensive and environmental health planning.
 - iv. Review of transportation plans.
- e. Describe the procedures designed to ensure that air quality maintenance activities and programs to be undertaken pursuant to the 10-year plan are coordinated with all other activities and programs being carried out in accordance with the applicable SIP.
- f. Provide a description of the resources available to the state and local agencies and the resources needed to carry out the entire SIP during the ensuing 5-year period, pursuant to 40 CFR 51.20. This should include a general description of the staff that will be required to prepare and implement the 10-year plan for each AQMA, and a proposed budget showing the costs of all

phases of the 10-year plan.

- g. Provide timetables that specify the dates by which classes of sources must comply with emission regulations. Also, provide a timetable for attaining secondary standards in each AQMA for each pollutant under consideration in the AQMA and, if the timetable is different from the one already in the SIP, provide an explanation of the difference.
- h. Describe the procedures used for evaluating the air quality implications of existing land use plans, transportation plans, and zoning maps.

3. Maintenance strategies

- a. The state shall provide a detailed description of the control strategies to be used in the plan pursuant to 40 CFR 51.12(a) through (d).

For each AQMA and for each problem pollutant within that AQMA (as identified through analysis in Group II above), the state shall describe the specific control strategy to be used, and show how that strategy will maintain pollutant levels within the standards.

- b. For strategies that will have an area-wide impact on emissions, the state shall provide a demonstration of that impact. All National Ambient Air Quality Standards shall be considered. Interrelationships among control strategies shall be discussed. Needed legal authority that might be innovative, unusual, or particularly difficult to obtain shall be described.

- c. The state shall provide results of all detailed analyses made to determine growth of emission sources in 1975 to 1985 together with the supporting rationale.
- d. The state shall provide results of all detailed analyses made to project emissions and air quality in 1975 to 1985, with the rationale supporting the projections.
- e. The strategies used in the plan may include the following considerations as the state finds they are necessary and applicable:
 - i. Emission density zoning--a regulatory system in which the maximum legal rate of emissions of air pollutants from any given land area is limited by the size of the area.
 - ii. Emission allocations--a regulatory system in which the maximum legal rate of emissions of air pollutants from any given political jurisdiction or other area is assigned by an allocation procedure and suitable restrictions are imposed if an area uses up its allocation.
 - iii. Transportation controls--including encouragement of mass transit and strategies discussed in the Preamble to State Implementation Plan Transportation Controls published in the Federal Register on November 6, 1973, pp. 30606 through 30633.
 - iv. A methodology for controlling proposed new or modified buildings, structures, facilities, or installation, including municipal waste water treatment facilities.
 - v. Fuel and energy conservation objectives.

- vi. Regulatory and other types of strategies to integrate air quality considerations into the development of area, point, and line sources, including zoning and subdivision regulations, sewer and water connection plans, rezoning and building plans, capital improvement programming, and open space reservations.
- vii. Mechanisms to integrate air quality considerations into revisions of local or regional development plans, and mechanisms to ensure that development proceeds in accordance with duly adopted plans.
- viii. The effects of more restrictive emission controls and new source performance standards.
- ix. Application of emission charges.
- x. Tighter control over construction activities, including grading and burning.
- xi. Any other pertinent strategies which are found to be necessary and applicable.